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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

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**Analysis and Design of Algorithms**" carried out by ARYAN MADHAN PILLAI**(1BM21CS033),** 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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Course Outcome

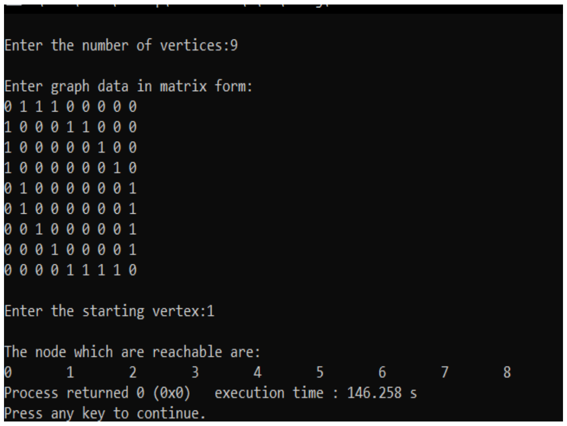
CO1	Analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.
CO2	Apply various design techniques for the given problem.
CO3	Apply the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete
CO4	Design efficient algorithms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

1(a).Write program to print all the nodes reachable from a given starting node in a digraph using BFS method.

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

int a[10][20], q[10], visited[10], n, i, j, f = 0, r = -1;

void bfs(int k) {
   for(i = 0; i < n; i++){
      if(a[k][i] && visited[i]==0){
         q[++r] = i;
      }
   }
   if(f <= r){
      visited[q[f]] = 1;
      bfs(q[f++]);
   }
}

int main() {
   int v;
   printf("\nEnter the number of vertices:");
   scanf("%d", &n);

   for(i=1; i <= n; i++) {
      q[i] = 0;
      visited[i] = 0;
   }

   printf("\nEnter graph data in matrix form:\n");
   for(i=0; i<n; i++) {
      for(j=0;j<n;j++) {
         scanf("%d", &a[i][j]);
      }
   }

   printf("\nEnter the starting vertex:");
   scanf("%d", &v);
   bfs(v);
   printf("\nThe node which are reachable are:\n");

   for(i=0; i < n; i++) {
      if(visited[i])
         printf("%d\t", i);
      else {
         printf("\nBfs is not possible. Not all nodes are reachable!\n");
         break;
      }
   }
   return 0;
}
```

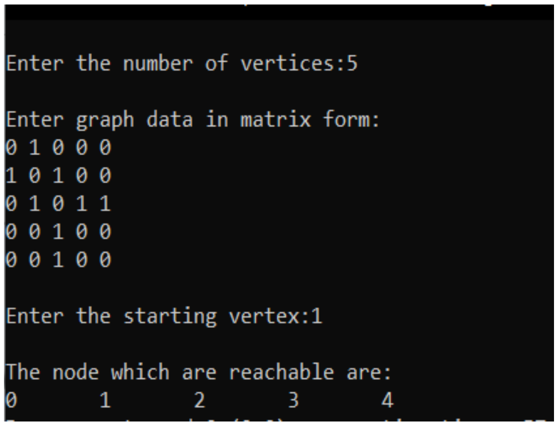
OUTPUT

CASE1:



```
Enter the number of vertices:9

Enter graph data in matrix form:
0 1 1 1 0 0 0 0 0
1 0 0 0 1 1 0 0 0
1 0 0 0 0 0 1 0 0
1 0 0 0 0 0 0 1 0
0 1 0 0 0 0 0 0 1
0 1 0 0 0 0 0 0 1
0 0 1 0 0 0 0 0 1
0 0 0 1 0 0 0 0 1
0 0 0 0 1 1 1 1 0

Enter the starting vertex:1

The node which are reachable are:
0       1       2       3       4       5       6       7       8
Process returned 0 (0x0)   execution time : 146.258 s
Press any key to continue.
```

CASE 2:



```
Enter the number of vertices:5

Enter graph data in matrix form:
0 1 0 0 0
1 0 1 0 0
0 1 0 1 1
0 0 1 0 0
0 0 1 0 0

Enter the starting vertex:1

The node which are reachable are:
0       1       2       3       4
```

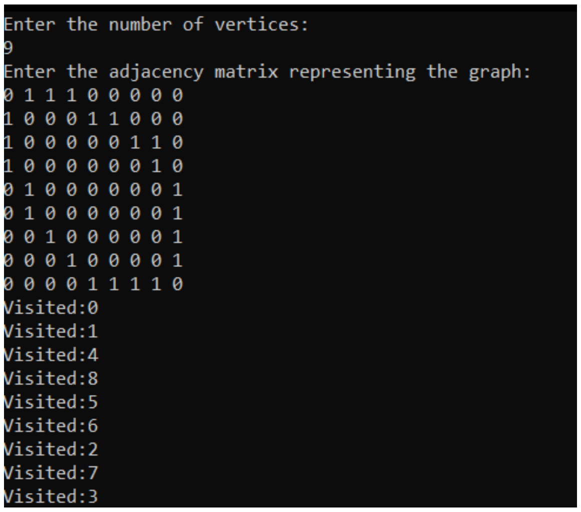
1(b).Write program to do the following check whether a given graph is connected or not using DFS method.

```
#include<stdio.h>

int graph[20][20], vis[10];

void DFS(int i,int n){
   int j;
   printf("Visited:%d\n",i);
   vis[i]=1;
   for(j=0;j<n;j++){
      if(graph[i][j]==1 && vis[j]==0){
         DFS(j,n);
      }
   }
}
void main(){

   int n,i,j,top=-1;
   printf("Enter the number of vertices:\n");
   scanf("%d",&n);
   printf("Enter the adjacency matrix representing the graph:\n");

   int vis[n],st[n];

   for(int i=0;i<n;i++){
      for(int j=0;j<n;j++){
         scanf("%d",&graph[i][j]);
      }
   }
   for(int i=0;i<n;i++){
      vis[i]=0;
   }
```

```
    DFS(0,n);
}
```

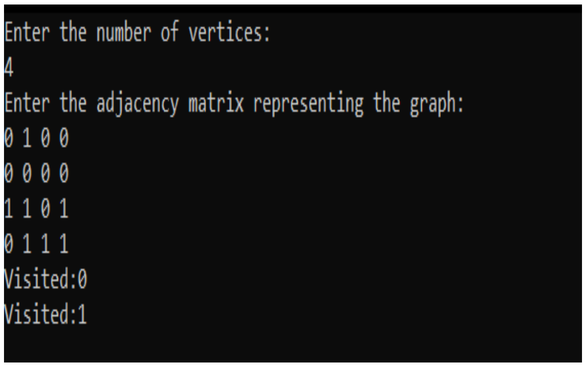
OUTPUT

CASE1:



```
Enter the number of vertices:
9
Enter the adjacency matrix representing the graph:
0 1 1 1 0 0 0 0 0
1 0 0 0 1 1 0 0 0
1 0 0 0 0 0 1 1 0
1 0 0 0 0 0 0 1 0
0 1 0 0 0 0 0 0 1
0 1 0 0 0 0 0 0 1
0 0 1 0 0 0 0 0 1
0 0 0 1 0 0 0 0 1
0 0 0 0 1 1 1 1 0
Visited:0
Visited:1
Visited:4
Visited:8
Visited:5
Visited:6
Visited:2
Visited:7
Visited:3
```

CASE2:



```
Enter the number of vertices:
4
Enter the adjacency matrix representing the graph:
0 1 0 0
0 0 0 0
1 1 0 1
0 1 1 1
Visited:0
Visited:1
```

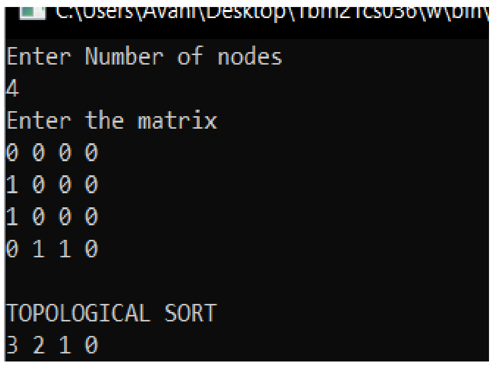
2. Write program to obtain the Topological ordering of vertices in a given digraph

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

int visited[50],graph[10][10],n,stack[10],top=-1;

void topological_sort(int node){
   visited[node]=1;

   for(int j=0;j<n;j++){
      if(graph[node][j]==1 && visited[j]!=1){
         topological_sort(j);
      }
   }

   stack[++top]=node;
}

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

```
    printf("\nTOPOLOGICAL SORT\n");
    while(top!=-1){
        printf("%d ",stack[top--]);
    }

return 0;
}
```

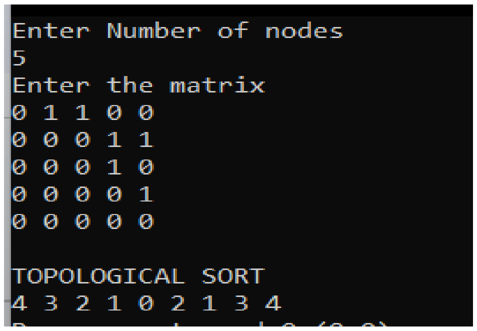
OUTPUT

CASE1:



```
C:\Users\Avani\Desktop\1bm21cs036\w\bin\

Enter Number of nodes
4
Enter the matrix
0 0 0 0
1 0 0 0
1 0 0 0
0 1 1 0

TOPOLOGICAL SORT
3 2 1 0
```

CASE 2:



```
Enter Number of nodes
5
Enter the matrix
0 1 1 0 0
0 0 0 1 1
0 0 0 1 0
0 0 0 0 1
0 0 0 0 0

TOPOLOGICAL SORT
4 3 2 1 0 2 1 3 4
```

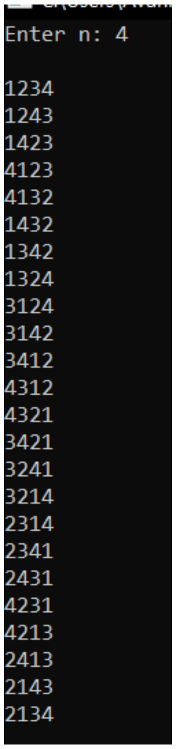
3. Implement Johnson Trotter algorithm to generate permutations.

```
#include  <stdio.h>

#include<conio.h>


int NN, i, count=0;

int p[100], pi[100];

int dir[100];


void PrintPerm()

{

  int i;

  for (i=1; i <= NN; ++i)

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

   printf("\n");

}


void Move( int x, int d )

{

  int z;

  z = p[pi[x]+d];

  p[pi[x]] = z;

  p[pi[x]+d] = x;

  pi[z] = pi[x];
  pi[x] = pi[x]+d;
}

void Perm ( int n )
{
  int i;
  if (n > NN)
    PrintPerm();
  else
  {
    Perm( n+1 );
    for (i=1; i<=n-1; ++i)
    {
      Move( n, dir[n] );
      Perm( n+1 );
    }
    dir[n] = -dir[n];
  }
}

void main ()
{
  printf( "Enter n: " );
  scanf( "%d", &NN );
```

```
   printf( "\n" );

   for (i=1; i<=NN; ++i)

   {

      dir[i] = -1; p[i] = i;

      pi[i] = i;

   }

   Perm ( 1 );

   printf( "\n" );

}
```

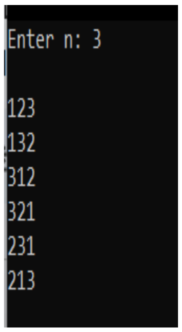
OUTPUT

CASE1:



```
Enter n: 4

1234
1243
1423
4123
4132
1432
1342
1324
3124
3142
3412
4312
4321
3421
3241
3214
2314
2341
2431
4231
4213
2413
2143
2134
```

CASE2:



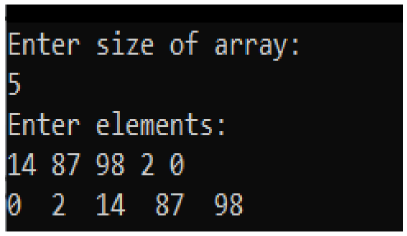
```
Enter n: 3

123
132
312
321
231
213
```

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.

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

int res[10], n;
void SortedMerge(int arr[], int l, int m, int h) {
   int i=l, j=m+1, k=0;

   while (i<=m && j<=h){
      if (arr[i]<arr[j]){
         res[k]=arr[i];
         i++;
      }
      else{
         res[k]=arr[j];
         j++;
      }
      k++;
   }
   while (i<=m){
      res[k++]=arr[i++];
   }
   while (j<=h){
      res[k]=arr[j];
      k++;
      j++;
   }
   for (int i=0; i<(h-l)+1; i++) {
      arr[l+i]=res[i];
   }
}
void Merge(int arr[], int l, int h){
   if (l<h){
        int m = (l+h)/2;
        Merge(arr, l, m);
        Merge(arr, m+1, h);
        SortedMerge(arr, l, m , h);
    }
}

int main(){
    int a[10],i;
    printf ("Enter size of array:\n");
    scanf("%d",&n);
    printf ("Enter elements:\n");
    for (i=0; i<n; i++){
        scanf("%d",&a[i]);
    }
    Merge(a,0,n-1);

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

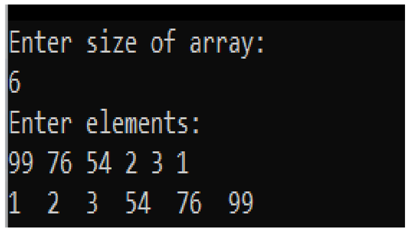
OUTPUT

CASE1:



```
Enter size of array:
5
Enter elements:
14 87 98 2 0
0  2  14  87  98
```

CASE2:



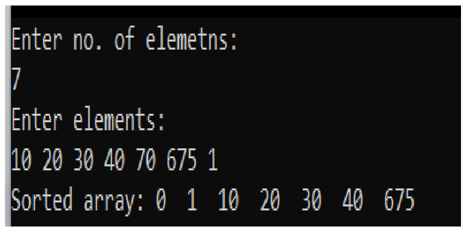
```
Enter size of array:
6
Enter elements:
99 76 54 2 3 1
1  2  3  54  76  99
```

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

```
#include <stdio.h>

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

int partition(int arr[], int low, int high) {
  int i=low, j=high+1;
  int pivot=arr[low];

  while (i<j){
    while (pivot >= arr[i]) i++;
    while (pivot < arr[j]) j--;

    if (i<j) swap(&arr[i], &arr[j]);
  }
  swap (&arr[low], &arr[j]);
  return j;
}

void quickSort(int arr[], int low, int high) {
  if (low < high) {
    int j = partition(arr, low, high);

    quickSort(arr, low, j-1);
    quickSort(arr, j+1, high);
  }
}

int main() {
  int arr[10], n, i;
```

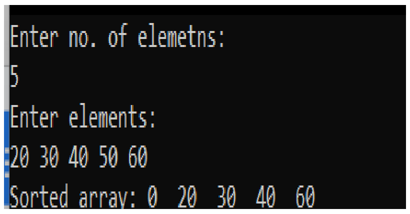
```
    printf("Enter no. of elemetns:\n");
    scanf ("%d", &n);

    printf ("Enter elements:\n");
    for (i=0; i<n; i++){
        scanf ("%d",&arr[i]);
    }
    quickSort(arr, 0, n-1);

    printf("Sorted array: ");
    for (i=0; i<n; i++){
        printf ("%d  ", arr[i]);
    }

    return 0;
}
```

OUTPUT
CASE1:



```
Enter no. of elemetns:
7
Enter elements:
10 20 30 40 70 675 1
Sorted array: 0  1  10  20  30  40  675
```

CASE2:



```
Enter no. of elemetns:
5
Enter elements:
20 30 40 50 60
Sorted array: 0  20  30  40  60
```

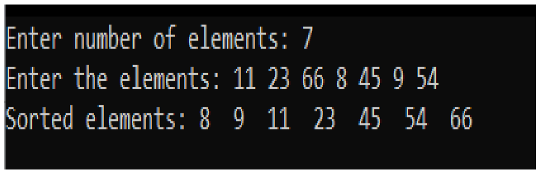
6. Sort a given set of N integer elements using Heap Sort technique and compute its time taken.

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

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

void heapify (int arr[], int n, int i){
    int largest = i, left = 2*i+1, 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);
   }
}

int main (){
   int n;

   printf ("Enter number of elements: ");
   scanf ("%d", &n);
   int arr[n];

   printf ("Enter the elements: ");
   for (int i = 0; i < n; i++){
      scanf ("%d", &arr[i]);
   }
   heapsort (arr, n);
```

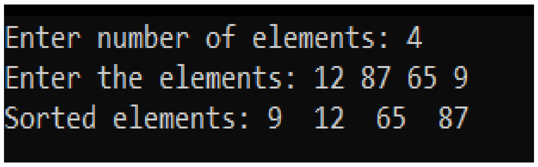
```
    printf ("Sorted elements: ");
    for (int i=0; i<n; i++){
        printf ("%d  ", arr[i]);
    }
    printf ("\n");
    return 0;
}
```

OUTPUT
CASE1:



```
Enter number of elements: 7
Enter the elements: 11 23 66 8 45 9 54
Sorted elements: 8  9  11  23  45  54  66
```

CASE2:



```
Enter number of elements: 4
Enter the elements: 12 87 65 9
Sorted elements: 9  12  65  87
```

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

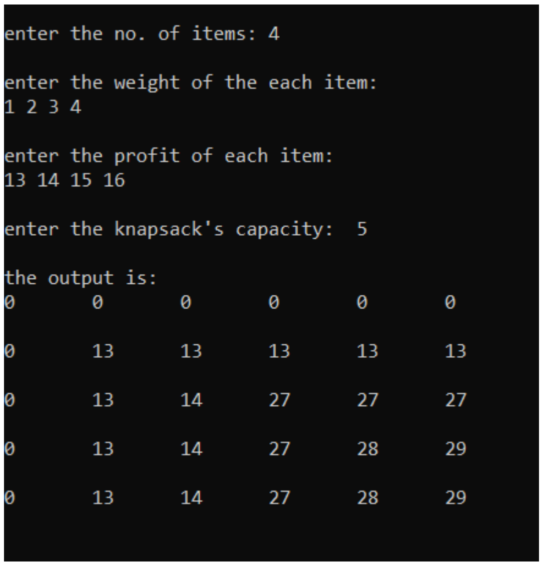
```
#include<stdio.h>

#include<conio.h>

void knapsack();

int max(int,int);

int i,j,n,m,p[10],w[10],v[10][10];

void main()

{

 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;
 }
}
```

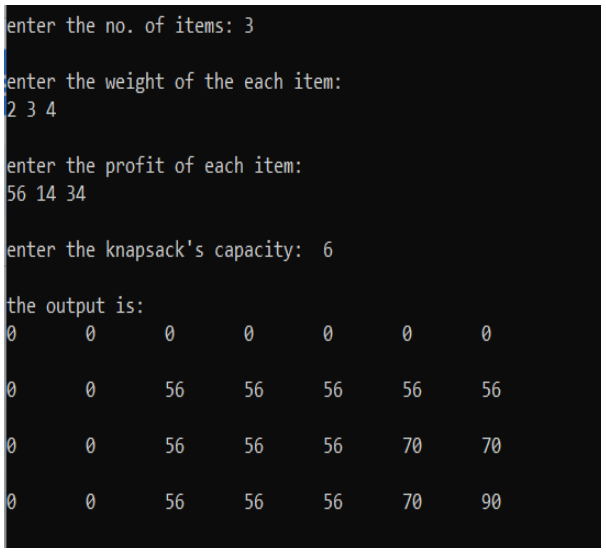
OUTPUT

CASE1:



```
enter the no. of items: 4

enter the weight of the each item:
1 2 3 4

enter the profit of each item:
13 14 15 16

enter the knapsack's capacity:  5

the output is:
0       0       0       0       0       0

0       13      13      13      13      13

0       13      14      27      27      27

0       13      14      27      28      29

0       13      14      27      28      29
```

CASE 2:



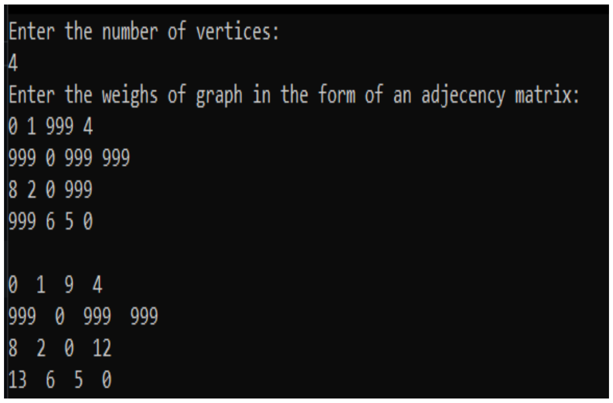
```
enter the no. of items: 3

enter the weight of the each item:
2 3 4

enter the profit of each item:
56 14 34

enter the knapsack's capacity:  6

the output is:
0       0       0       0       0       0       0

0       0       56      56      56      56      56

0       0       56      56      56      70      70

0       0       56      56      56      70      90
```

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

```
#include  <stdio.h>

#include <stdlib.h>

#include <limits.h>


int min (int a, int b) {

   return a < b ? a : b;

}


int main(){

   int n, graph[10][10], i, j, k;

   printf("Enter the number of vertices:\n");

   scanf("%d",&n);

   printf("Enter the weighs of graph in the form of an adjecency matrix:\n");

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

      for (int j=0; j<n; j++) {

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


         if (i==j) graph[i][j]=0;


         else if (graph[i][j]==0) graph[i][j] = INT_MAX/3;

      }

   }

   for (k=0; k<n; k++) {
        for (i=0; i<n; i++){
            for (j=0; j<n; j++){
                graph[i][j] = min(graph[i][j], graph[i][k]+graph[k][j]);
            }
        }
    }

    for (i=0; i<n; i++){
        printf ("\n");
        for (j=0; j<n; j++) {
            printf ("%d  ", graph[i][j]);
        }
    }

    return 0;
}
```

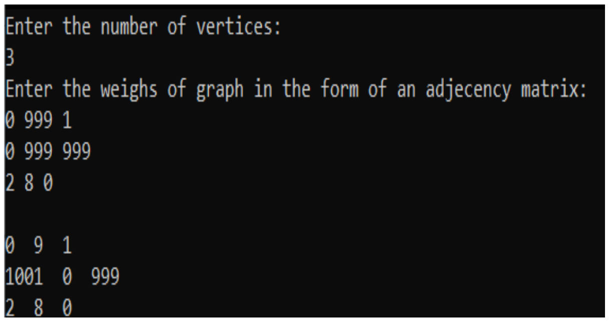
OUTPUT

CASE 1:



```
Enter the number of vertices:
4
Enter the weighs of graph in the form of an adjecency matrix:
0 1 999 4
999 0 999 999
8 2 0 999
999 6 5 0

0  1  9  4
999  0  999  999
8  2  0  12
13  6  5  0
```

CASE 2:



```
Enter the number of vertices:
3
Enter the weighs of graph in the form of an adjecency matrix:
0 999 1
0 999 999
2 8 0

0  9  1
1001  0  999
2  8  0
```

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

PRIMS ALGORITHM

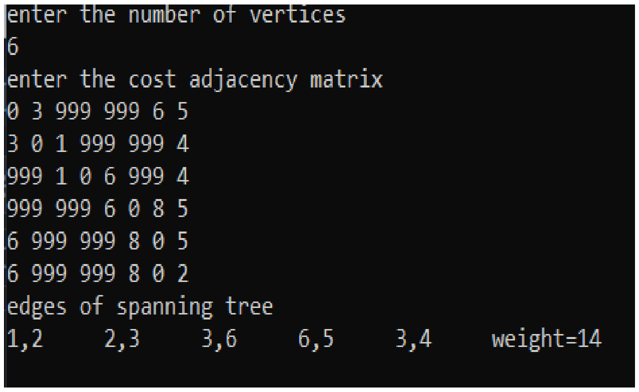
```
#include<stdio.h>


int cost[10][10],vt[10],et[10][10],vis[10],j,n;

int sum=0;

int x=1;

int e=0;

void prims();


int main()

{

  int i;

  printf("enter the number of vertices\n");

  scanf("%d",&n);

  printf("enter the cost adjacency matrix\n");

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

  {

     for(j=1;j<=n;j++)

     {

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

     }
```

```
      vis[i]=0;
   }
   prims();
   printf("edges of spanning tree\n");
   for(i=1;i<=e;i++)
   {
         printf("%d,%d\t",et[i][0],et[i][1]);
   }
   printf("weight=%d\n",sum);
  return 0;
}

void prims()
{
  int s,min,m,k,u,v;
  vt[x]=1;
  vis[x]=1;
  for(s=1;s<n;s++)
  {
      j=x;
      min=999;
      while(j>0)
      {
            k=vt[j];
```

```
                for(m=2;m<=n;m++)
                {
                  if(vis[m]==0)
                  {
                         if(cost[k][m]<min)
                         {
                            min=cost[k][m];
                            u=k;
                            v=m;
                         }
                   }
               }
               j--;
     }
     vt[++x]=v;
     et[s][0]=u;
     et[s][1]=v;
     e++;
     vis[v]=1;
     sum=sum+min;
  }
}
```

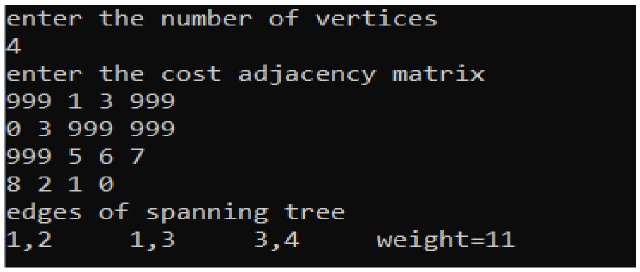
OUTPUT

CASE1:



```
enter the number of vertices
6
enter the cost adjacency matrix
0 3 999 999 6 5
3 0 1 999 999 4
999 1 0 6 999 4
999 999 6 0 8 5
6 999 999 8 0 5
6 999 999 8 0 2
edges of spanning tree
1,2     2,3     3,6     6,5     3,4     weight=14
```

CASE 2:



```
enter the number of vertices
4
enter the cost adjacency matrix
999 1 3 999
0 3 999 999
999 5 6 7
8 2 1 0
edges of spanning tree
1,2     1,3     3,4     weight=11
```

KRUSHKALS ALGORITHM

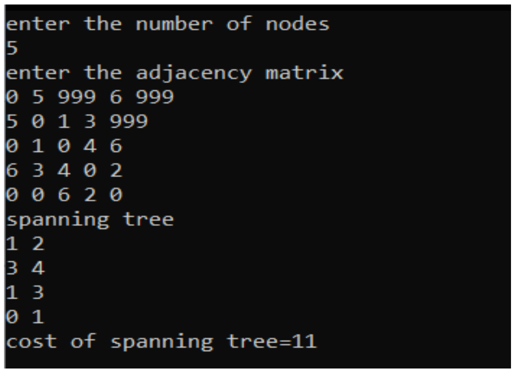
```
#include <stdio.h>

int find(int v, int parent[10])
{
  while (parent[v] != v)
  {
    v = parent[v];
  }
  return v;
}

void union1(int i, int j, int parent[10])
{
  if (i < j)
    parent[j] = i;
  else
    parent[i] = j;
}

void kruskal(int n, int a[10][10])
{
  int count, k, min, sum, i, j, t[10][10], u, v, parent[10];
  count = 0;
  k = 0;
  sum = 0;
  for (i = 0; i < n; i++)
    parent[i] = i;
  while (count != n - 1)
  {
    min = 999;
    for (i = 0; i < n; i++)
    {
      for (j = 0; j < n; j++)
      {

        if (a[i][j] < min && a[i][j] != 0)
```

```
            {
               min = a[i][j];
               u = i;
               v = j;
            }
         }
      }
      i = find(u, parent);
      j = find(v, parent);
      if (i != j)
      {
         union1(i, j, parent);
         t[k][0] = u;
         t[k][1] = v;
         k++;
         count++;
         sum = sum + a[u][v];
      }
      a[u][v] = a[v][u] = 999;
   }
   if (count == n - 1)
   {
      printf("spanning tree\n");
      for (i = 0; i < n - 1; i++)
      {
         printf("%d %d\n", t[i][0], t[i][1]);
      }
      printf("cost of spanning tree=%d\n", sum);
   }
   else
      printf("spanning tree does not exist\n");
}

int main()
{
   int n, i, j, a[10][10];
   printf("enter the 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]);
  }
  kruskal(n, a);
  return 0;
}
```

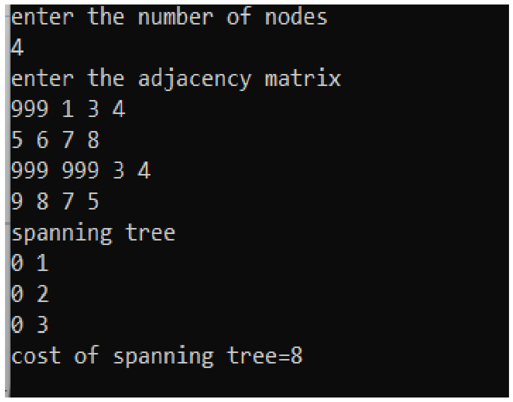
OUTPUT

CASE 1:



```
enter the number of nodes
5
enter the adjacency matrix
0 5 999 6 999
5 0 1 3 999
0 1 0 4 6
6 3 4 0 2
0 0 6 2 0
spanning tree
1 2
3 4
1 3
0 1
cost of spanning tree=11
```

CASE 2:



```
enter the number of nodes
4
enter the adjacency matrix
999 1 3 4
5 6 7 8
999 999 3 4
9 8 7 5
spanning tree
0 1
0 2
0 3
cost of spanning tree=8
```

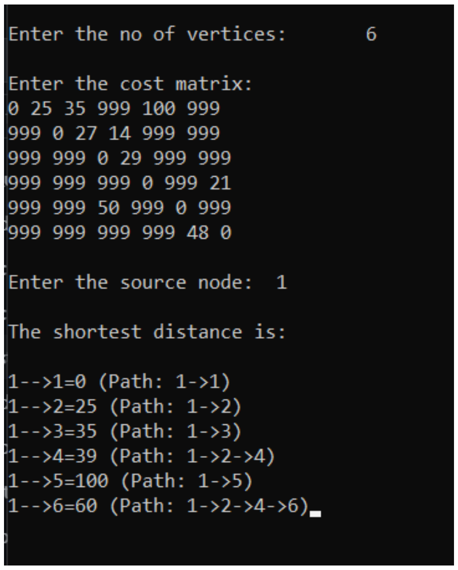
10. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra’s algorithm.

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

void dijkstras();
int c[10][10], n, src;
void printPath(int parent[], int node);

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]);
        }
    }
    printf("\nEnter the source node:\t");
    scanf("%d", &src);
    dijkstras();
    getch();
}

void dijkstras()
{
    int vis[10], dist[10], parent[10], u, j, count, min;
    for (j = 1; j <= n; j++)
    {
        dist[j] = c[src][j];
        parent[j] = src;
    }
    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];
                parent[j] = u;
            }
        }
    }
    printf("\nThe shortest distance is:\n");
    for (j = 1; j <= n; j++)
    {
        printf("\n%d-->%d=%d (Path: %d", src, j, dist[j], src);
        printPath(parent, j);
        printf(")");
    }
}

void printPath(int parent[], int node)
```

```
{
   if (parent[node] == src)
   {
      printf("->%d", node);
      return;
   }
   printPath(parent, parent[node]);
   printf("->%d", node);
}
```

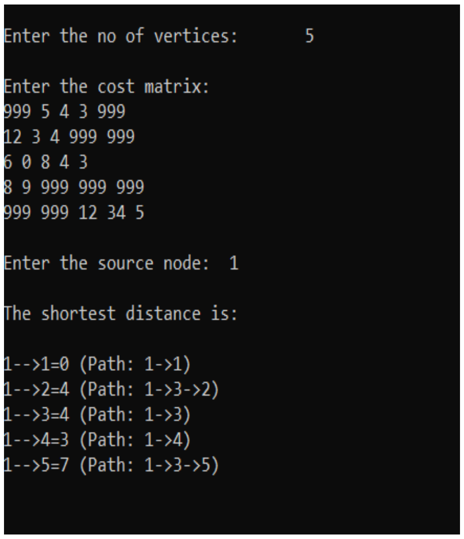
OUTPUT

CASE 1:



```
Enter the no of vertices:       6

Enter the cost 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

Enter the source node:  1

The shortest distance is:

1-->1=0 (Path: 1->1)
1-->2=25 (Path: 1->2)
1-->3=35 (Path: 1->3)
1-->4=39 (Path: 1->2->4)
1-->5=100 (Path: 1->5)
1-->6=60 (Path: 1->2->4->6)
```

CASE 2:



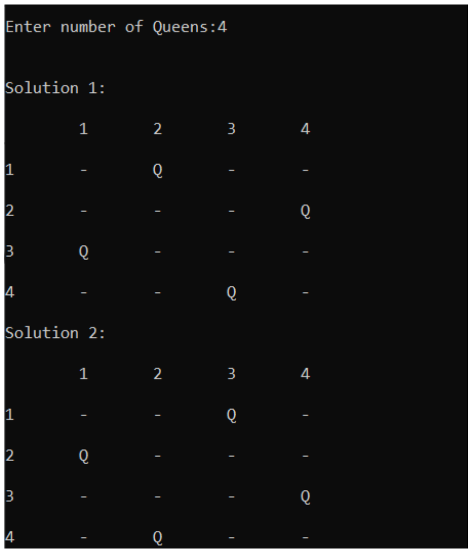
```
Enter the no of vertices:       5

Enter the cost matrix:
999 5 4 3 999
12 3 4 999 999
6 0 8 4 3
8 9 999 999 999
999 999 12 34 5

Enter the source node:  1

The shortest distance is:

1-->1=0 (Path: 1->1)
1-->2=4 (Path: 1->3->2)
1-->3=4 (Path: 1->3)
1-->4=3 (Path: 1->4)
1-->5=7 (Path: 1->3->5)
```

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

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

int board[20],count;

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

printf(" - N Queens Problem Using Backtracking -");
printf("\n\nEnter 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);
  }
}
}
```

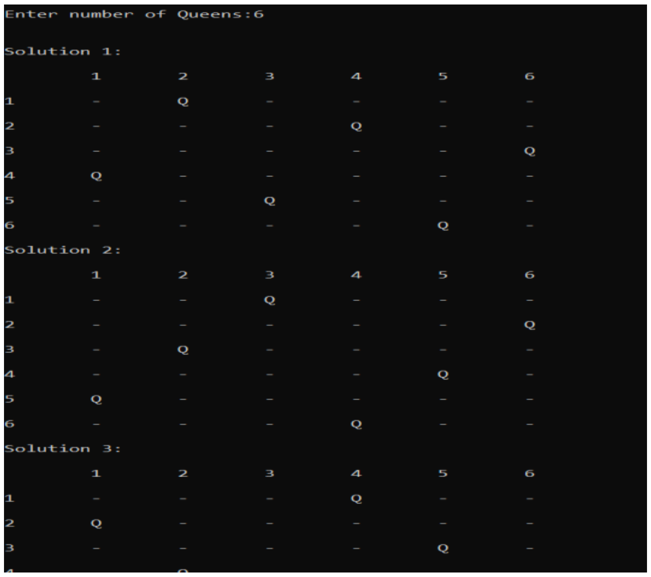
OUTPUT

CASE 1:

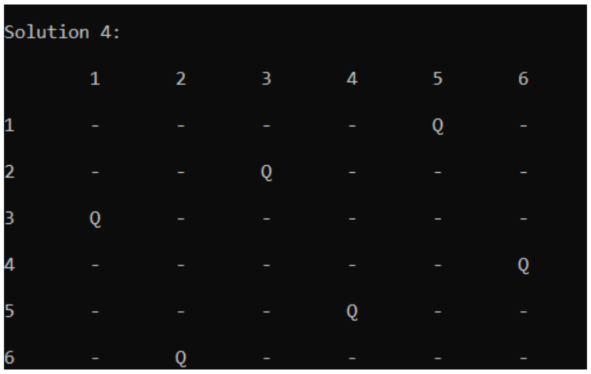


```
Enter number of Queens:4

Solution 1:
        1       2       3       4
1       -       Q       -       -
2       -       -       -       Q
3       Q       -       -       -
4       -       -       Q       -
Solution 2:
        1       2       3       4
1       -       -       Q       -
2       Q       -       -       -
3       -       -       -       Q
4       -       Q       -       -
```

CASE 2:



```
Enter number of Queens:6

Solution 1:
        1       2       3       4       5       6
1       -       Q       -       -       -       -
2       -       -       -       Q       -       -
3       -       -       -       -       -       Q
4       Q       -       -       -       -       -
5       -       -       Q       -       -       -
6       -       -       -       -       Q       -
Solution 2:
        1       2       3       4       5       6
1       -       -       Q       -       -       -
2       -       -       -       -       -       Q
3       -       Q       -       -       -       -
4       -       -       -       -       Q       -
5       Q       -       -       -       -       -
6       -       -       -       Q       -       -
Solution 3:
        1       2       3       4       5       6
1       -       -       -       Q       -       -
2       Q       -       -       -       -       -
3       -       -       -       -       Q       -
```



```
Solution 4:
        1       2       3       4       5       6
1       -       -       -       -       Q       -
2       -       -       Q       -       -       -
3       Q       -       -       -       -       -
4       -       -       -       -       -       Q
5       -       -       -       Q       -       -
6       -       Q       -       -       -       -
```