VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Analysis and Design of Algorithms

Submitted by

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

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

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**Analysis and Design of Algorithms**" carried out by Gagan D A (1BM21CS063)**,** 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 May-2023 to July-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.

PROGRAM 1

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.

1.1 BFS Traversal

1.1.1 CODE

```
#include<stdio.h>
#include<conio.h>
void insert_rear(int q[],int *r, int item, int size)
{
    if(*r==size)
    printf("Queue overflow!\n");
    else
    {
        *r=*r+1;
        q[*r]=item;
    }
}
int delete_front(int q[],int *r, int *f)
{
    int del_item=-1;
    *f=*f+1;
    del_item=q[*f];
     return del_item;
}
int isEmpty(int q[], int *r, int *f)
{
    if(*r==-1 || *r==*f)
    return 1;
```

```
    else
    return 0;
}
void main()
{
    int n,i,j,r=-1,f=-1;
    printf("Enter the number of vertices:\n");
    scanf("%d",&n);
    printf("Enter the adjacency matrix representing the graph:\n");
    int graph[n][n];
    int vis[n],q[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;
    }
    printf("The BFS travsersal is:\n");
    int k=0;
    printf("%d ",k); // print the first node
    vis[k]=1; //Make the first node visited
    insert_rear(q,&r,k,n); // Insert the node in the queue
    while(isEmpty(q,&r,&f)==0) // if queue is not empty
    {
        int node=delete_front(q,&r,&f); //remove node from queue
```

```
        for(j=0;j<n;j++)
        {
            if(graph[node][j]==1 && vis[j]==0) /*if the child of node removed exits and is not
visited, make it visited.
                                                1.print the child
                                                2.make the node visited.
                                                3.insert the child into the queue*/
            {
                printf("%d ",j);
                vis[j]=1;
                insert_rear(q,&r,j,n);
            }
        }
    }
}
```

1.1.2 OUTPUT

```
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
if ($?) { .\Lab2-BFS }
Enter the number of vertices:
8
Enter the adjacency matrix representing the graph:
0 1 1 1 0 0 0 0
0 0 0 1 0 0 0 0
0 0 0 1 1 0 0 0
0 0 0 0 0 1 0 0
0 0 0 0 0 1 1 0
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0
The BFS traversal is:
0 1 2 3 4 5 6 7
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
```

1.2 DFS Traversal

1.2.1 CODE

```
#include<stdio.h>
int graph[20][20];
void DFS(int i,int vis[],int n)
{
   int j;
   printf("%d ",i); // print the source node
   vis[i]=1; // make the source node visited
   for(j=0;j<n;j++)
   {
      if(graph[i][j]==1 && vis[j]==0) // for every adjacent vertex that is not visited
      {
         DFS(j,vis,n); // recursive call to DFS- because we need to print the nodes depth wise
      }
   }
}
void main()
{
   int n,i,j,top=-1,isConnected;
   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;
    }
    printf("The DFS traversal is:\n");
    DFS(0,vis,n);
    printf("\n");
    isConnected=1;
    for(int i=0;i<n;i++)
    {
        if(vis[i]==0)
        {
            isConnected=0;
            break;
        }
    }
    if(isConnected)
    printf("The graph is connected.\n");
    else
    printf("The graph is not connected:\n");
}
```

1.2.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab> cd
FS }
Enter the number of vertices:
6
Enter the adjacency matrix representing the graph:
0 1 1 0 0 0
0 0 0 1 1 0
0 0 0 0 0 1
0 1 0 0 0 0
0 1 0 0 0 0
0 0 1 0 0 0
The DFS traversal is:
0 1 3 4 2 5
The graph is connected.
```

PROGRAM 2

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

2.1 CODE

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

int s[100], j, res[100];
void AdjacencyMatrix(int a[][100], int n)
{
   for(int i=0;i<n;i++)
   {
      for(int j=0;j<n;j++)
      {
         scanf("%d",&a[i][j]);
      }
   }
   return;
}
void dfs(int u, int n, int a[][100])
{
   int v;
   s[u] = 1;
   for (v = 0; v < n ; v++) {
      if (a[u][v] == 1 && s[v] == 0) {
         dfs(v, n, a);
      }
   }
   j += 1;
   res[j] = u; // Store every dead node in the array
```

```
}
void topological_order(int n, int a[][100])
{
    int i, u;
    for (i = 0; i < n; i++) {
        s[i] = 0;
    }
    j = 0;
    for (u = 0; u < n; u++) {
        if (s[u] == 0) {
            dfs(u, n, a);
        }
    }
}
void main() {
    int a[100][100], n, i, j;

    printf("Enter number of vertices:\n"); /* READ NUMBER OF VERTICES */
    scanf("%d", &n);
    printf("Enter the adjacency matrix:\n");
    AdjacencyMatrix(a, n);
    topological_order(n, a);
    printf("The topological sort order is:\n");
    for (i = n; i >=1; i--) /*Inside the array 'res', we are adding the nodes that become dead
from first to last.
                              But topological sort is the reverse order.So we are printing the array
backwards.*/
    {
        printf("%d ", res[i]);
    }
}
```

2.2 OUTPUT

```
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
opological_sort } ; if ($?) { .\Lab3_Topological_sort }
Enter number of vertices:
8
Enter the adjacency matrix:
0 1 1 1 0 0 0 0
0 0 0 1 0 0 0 0
0 0 0 1 1 0 0 0
0 0 0 0 0 1 0 0
0 0 0 0 0 1 1 0
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0
The topological sort order is:
0 2 4 6 1 3 5 7
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
```

PROGRAM 3

Implement Johnson Trotter algorithm to generate permutations.

3.1 CODE

```
#include <stdio.h>
#define RIGHT_TO_LEFT 0
#define LEFT_TO_RIGHT 1
void swap(int *a, int *b)
{
    int temp = *a;
    *a = *b;
    *b = temp;
}
int searchArr(int a[], int n, int mobile)
{
    for (int i = 0; i < n; i++) {
        if (a[i] == mobile) {
            return i + 1;
        }
    }
    return -1;  // Mobile not found
}
int getMobile(int a[], int dir[], int n)
{
    int mobile_prev = 0, mobile = 0;
    for (int i = 0; i < n; i++) {
        // Direction 0 represents RIGHT TO LEFT.
        if (dir[a[i] - 1] == RIGHT_TO_LEFT && i != 0)
        {
            if (a[i] > a[i - 1] && a[i] > mobile_prev)
```

```
            {
                mobile = a[i];
                mobile_prev = mobile;
            }
        }
        if (dir[a[i] - 1] == LEFT_TO_RIGHT && i != n - 1)
        {
            if (a[i] > a[i + 1] && a[i] > mobile_prev)
            {
                mobile = a[i];
                mobile_prev = mobile;
            }
        }
    }
if (mobile == 0 && mobile_prev == 0)
    {
        return 0;  // No mobile element found
    } else {
        return mobile;
    }
}
void printOnePerm(int a[], int dir[], int n)
{
    int mobile = getMobile(a, dir, n);
    int pos = searchArr(a, n, mobile);
   if (dir[a[pos - 1] - 1] == RIGHT_TO_LEFT)
    {
        swap(&a[pos - 1], &a[pos - 2]);
    } else if (dir[a[pos - 1] - 1] == LEFT_TO_RIGHT)
    {
```

```
        swap(&a[pos], &a[pos - 1]);
    }
for (int i = 0; i < n; i++) {
        if (a[i] > mobile) {
            if (dir[a[i] - 1] == LEFT_TO_RIGHT)
            {
                dir[a[i] - 1] = RIGHT_TO_LEFT;
            } else if (dir[a[i] - 1] == RIGHT_TO_LEFT)
            {
                dir[a[i] - 1] = LEFT_TO_RIGHT;
            }
        }
    }
    for (int i = 0; i < n; i++)
    {
        printf("%d ", a[i]);
    }
    printf("\n");
}
int factorial(int n)
{
    int res = 1;
    for (int i = 1; i <= n; i++)
    {
        res = res * i;
    }
    return res;
}
void printPermutation(int n)
{
```

```
    int a[n];
    int dir[n];

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

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

    for (int i = 1; i < factorial(n); i++)
    {
        printOnePerm(a, dir, n);
    }
}
int main()
{
    int n;
    printf("Enter the value of n: ");
    scanf("%d", &n);
    printPermutation(n);
    return 0;
}
```

3.2 OUTPUT

```
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
hnson-trotter } ; if ($?) { .\Lab4-Johnson-trotter }
Enter the value of n: 4
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
PS C:\Users\neha2\OneDrive\Documents\1BM21CS113_ADA_Lab>
```

PROGRAM 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.

4.1 CODE

```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
void conquor(int arr[], int s,int mid,int e)
{
   int merged[e-s+1];
   int i1=s;
   int i2=mid+1;
   int x=0;
   while(i1<=mid && i2<=e)
   {
      if(arr[i1]<=arr[i2])
      {
         merged[x]=arr[i1];
         x++;
         i1++;
      }
      else
      {
         merged[x]=arr[i2];
         x++;
         i2++;
      }
   }
   while(i1<=mid)
```

```
    {
        merged[x]=arr[i1];
        x++;
        i1++;
    }
    while(i2<=e)
    {
        merged[x]=arr[i2];
        x++;
        i2++;
    }
    for(int i=0;i<x;i++)
    {
        arr[i+s]=merged[i];
    }

}
void divide(int arr[], int s, int e)
{
    if(s>=e)
    return;
    int mid=s+(e-s)/2;
    divide(arr,s,mid);
    divide(arr,mid+1,e);
    conquor(arr,s,mid,e);
}
void main()
{
    clock_t st,et;
    double ts;
```

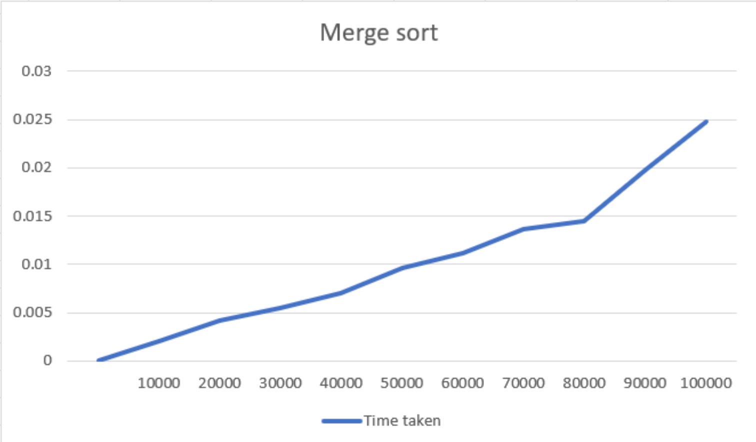
```
    int n= rand()%100+50; // General formala is: rand()%range+min
    printf("Size of array:%d\n",n);
    int arr[n];
    for(long i=0;i<n;i++)
    {
        arr[i]=rand()%100+1;//random number from 1 to 100
    }
    /*printf("Original array:\n");
    for(int i=0;i<n;i++)
    {
        printf("%d ",arr[i]);
    }
    printf("\n");*/
    st=clock();
    divide(arr,0,n-1);
    et=clock();
    ts=(double)((et-st)/CLOCKS_PER_SEC);
    printf("Sorted array:\n");
    for(long i=0;i<n;i++)
    {
        printf("%d ",arr[i]);
    }
    printf("\nThe time taken for merge sort is: %f\n",ts);
}
```

4.2 OUTPUT

```
PS C:\Users\neha2\OneDrive\Documents\ADA_practice>
.\Mergesort }
Enter the number of elements in the array:
5
Enter 5 elements of the array:
5 4 3 2 1
Original array:
5 4 3 2 1
Sorted array:
1 2 3 4 5
```

4.3 GRAPH TO SHOW TIME COMPLEXITY

Input size(n)	Time taken
10000	0.002114
20000	0.00418
30000	0.005486
40000	0.007019
50000	0.00969
60000	0.011191
70000	0.013704
80000	0.014539
90000	0.019828
100000	0.024749



PROGRAM 5

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

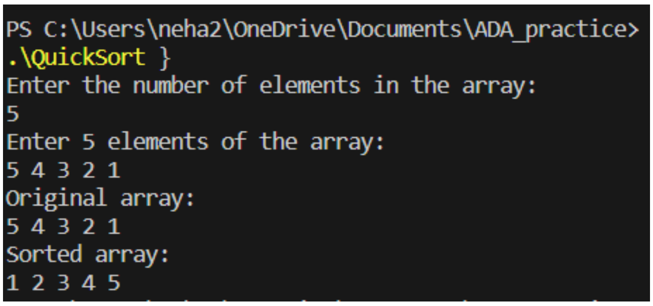
5.1 CODE

```
#include<stdio.h>
#include<time.h>
int partition(int arr[], int low, int high) {
int pivot = arr[low]; // Use the first element as the pivot
    int i = low;
    int j = high + 1;
    int temp;
    while (1)
    {
        do
        {
            i++;
        }while (arr[i] <= pivot && i <= high);

        do
        {
            j--;
        }while (arr[j] > pivot && j >= low);

        if (i >= j) {
            break;
        }
        temp = arr[i];
        arr[i] = arr[j];
        arr[j] = temp;
```

```
    }

    // Swap arr[low] (pivot) and arr[j]
    temp = arr[low];
    arr[low] = arr[j];
    arr[j] = temp;

    return j;
}

void quickSort(int arr[], int low, int high) {
    if (low < high) {
        int pidx = partition(arr, low, high);
        quickSort(arr, low, pidx - 1);
        quickSort(arr, pidx + 1, high);
    }
}
int main() {
    int n;
    clock_t st,et;
    double ts;
    printf("Enter the number of elements in the array:\n");
    scanf("%d", &n);
    int arr[n];
    printf("Enter %d elements of array:\n", n);
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    st=clock();
    quickSort(arr, 0, n - 1);
```

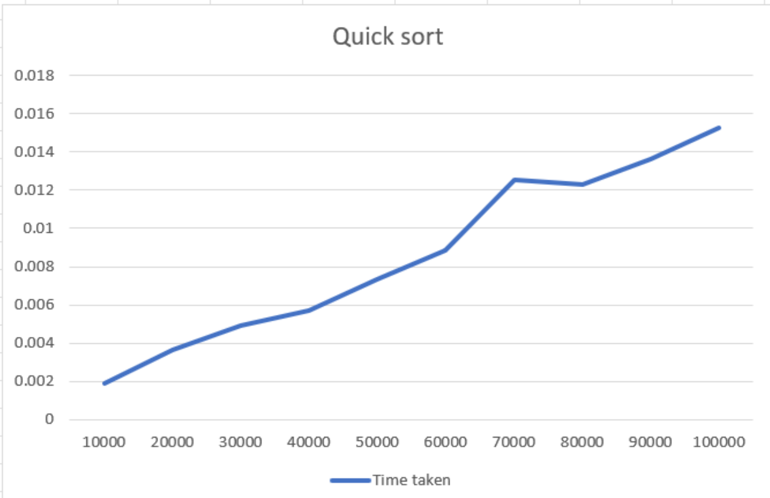
```
    et=clock();
    ts=(double)((et-st)/CLOCKS_PER_SEC);
    printf("The sorted array is:\n");
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
    printf("Time taken for quick sort:%f\n",ts);
    return 0;
}
```

5.2 OUTPUT



5.3 GRAPH TO SHOW TIME COMPLEXITY

Input size(n)	Time taken
10000	0.001908
20000	0.003618
30000	0.004931
40000	0.005698
50000	0.00735
60000	0.008865
70000	0.012559
80000	0.012323
90000	0.013631
100000	0.015273



PROGRAM 6

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

6.1 CODE

```
#include <stdio.h>
void swap(int *a, int *b)
{
    int temp = *a;
    *a = *b;
    *b = temp;
}
void heapify(int a[], int n, int i)
{
    int largest = i;
    int l = 2 * i + 1;
    int r = 2 * i + 2;

    if (l < n && a[l] > a[largest])
    {
        largest = l;
    }
    if (r < n && a[r] > a[largest])
    {
        largest = r;
    }
    if (largest != i)
    {
        swap(&a[i], &a[largest]);
        heapify(a, n, largest);
    }
```

```
}
void heapSort(int a[], int n)
{
    for (int i = n / 2 - 1; i >= 0; i--)
    {
        heapify(a, n, i);
    }
for (int i = n - 1; i > 0; i--)
    {
        swap(&a[0], &a[i]);
        heapify(a, i, 0);
    }
}
int main()
{
    int n;
    printf("Enter the number of elements in the array:\n");
    scanf("%d",&n);
    int arr[n];
    printf("Enter %d elements:\n",n);
    for(int i=0;i<n;i++)
    {
        scanf("%d",&arr[i]);
    }
    printf("Original array: ");
    for (int i = 0; i < n; i++)
    {
        printf("%d ", arr[i]);
    }
    printf("\n");
```

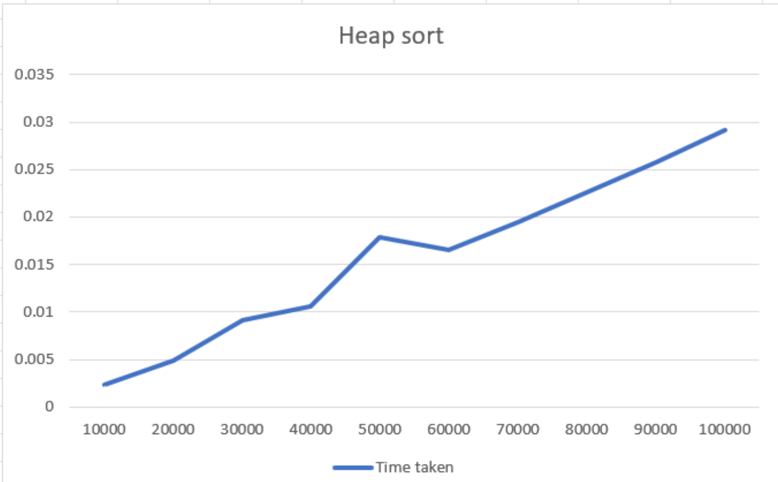
```
    heapSort(arr, n);
   printf("Sorted array: ");
   for (int i = 0; i < n; i++)
   {
       printf("%d ", arr[i]);
   }
   printf("\n");
    return 0;
}
```

6.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab>
{ .\Lab7-HeapSort }
Enter the number of elements in the array:
6
Enter 6 elements:
7 2 9 1 0 -1
Original array: 7 2 9 1 0 -1
Sorted array: -1 0 1 2 7 9
```

6.3 GRAPH TO SHOW TIME COMPLEXITY

Input size(n)	Time taken
10000	0.002324
20000	0.004903
30000	0.009185
40000	0.010584
50000	0.017871
60000	0.016515
70000	0.019496
80000	0.022587
90000	0.025799
100000	0.029185



PROGRAM 7

Implement 0/1 Knapsack problem using dynamic programming.

7.1 CODE

```
#include<stdio.h>
void main()
{
    int n,cap;
    printf("Enter the number of items:\n");
    scanf("%d",&n);
    int wt[n],pft[n];
    printf("Enter the weights of %d items:\n",n);
    for(int i=0;i<n;i++)
    {
        scanf("%d",&wt[i]);

    }
    printf("Enter the profit of %d items:\n",n);
    for(int i=0;i<n;i++)
    {
        scanf("%d",&pft[i]);
    }
    printf("Enter the capacity of the sack:\n");
    scanf("%d",&cap);
    int v[n+1][cap+1];
    for(int i=0;i<=n;i++)
    {
        for(int j=0;j<=cap;j++)
        {
            if(i==0 || j==0)
```

```
            v[i][j]=0;
            else if(j<wt[i-1])
            {
                v[i][j]=v[i-1][j];
            }
            else if(j>=wt[i-1])
            {
                if(v[i-1][j]>=(v[i-1][j-wt[i-1]]+pft[i-1]))
                v[i][j]=v[i-1][j];
                else
                v[i][j]=v[i-1][j-wt[i-1]]+pft[i-1];
            }
        }
    }
    printf("The table is:\n");
    for(int i=0;i<=n;i++)
    {
        for(int j=0;j<=cap;j++)
        {
            printf("%d     ",v[i][j]);
        }
        printf("\n");
    }
    printf("The maximum profit is %d.\n",v[n][cap]);
}
```

7.2 OUTPUT

```
Enter the number of items:
4
Enter the weights of 4 items:
2 1 3 2
Enter the profit of 4 items:
12 10 20 15
Enter the capacity of the sack:
5
The table is:
0      0      0      0      0      0
0      0      12     12     12     12
0      10     12     22     22     22
0      10     12     22     30     32
0      10     15     25     30     37
The maximum profit is 37.
```

PROGRAM 8

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

8.1 CODE

```
#include<stdio.h>
void main()
{
  int n,i,j,k;
  printf("Enter the number of vertices:\n");
  scanf("%d",&n);
  int graph[n][n];
  printf("Enter the cost matrix of the graph:\n");
  for(i=0;i<n;i++)
  {
    for(j=0;j<n;j++)
    {
      scanf("%d",&graph[i][j]);
    }
  }
  for(k=0;k<n;k++)
  {
    for(i=0;i<n;i++)
    {
      for(j=0;j<n;j++)
      {
        if(graph[i][j]>graph[i][k]+graph[k][j])
        graph[i][j]=graph[i][k]+graph[k][j];
      }
    }
  }
 printf("The floyds matrix is:\n");
```

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

8.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab>
Lab6-Flyods }
Enter the number of vertices:
4
Enter the cost matrix of the graph:
0 999 3 999
2 0 999 999
999 7 0 1
6 999 999 0
The floyds matrix is:
0   10   3   4
2   0   5   6
7   7   0   1
6   16   9   0
```

PROGRAM 9

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

9.1 Prims algorithm

9.1.1 CODE

```
#include<stdio.h>
#include<conio.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();

void 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);

}

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;
    }
}
```

9.1.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab> cd
b6-Prims }
Enter the number of vertices:
4
Enter the cost adjacency matrix:
0 3 2 1
999 0 999 4
999 999 0 999
999 999 6 0
Edges of spanning tree
1,4     1,3     1,2     Weight=6
```

9.2 Kruskals Algorithm

9.2.1 CODE

```
#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");
 }
void 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);
 }
```

9.2.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab>
.\Lab6-Kruskal }
Enter the number of nodes:
4
Enter the adjacency matrix:
0 3 2 1
999 0 999 4
999 999 0 999
999 999 6 0
Spanning tree
0 3
0 2
0 1
Cost of spanning tree=6
```

PROGRAM 10

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

10.1 CODE

```
#include <limits.h>

#include <stdbool.h>

#include <stdio.h>

int minDistance(int dist[], bool sptSet[],int V)

{

  int min = INT_MAX, min_index;

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

   if (sptSet[v] == false && dist[v] <= min)

    min = dist[v], min_index = v;

    return min_index;

}

void printSolution(int dist[], int V)

{

printf("Vertex \t\t Distance from Source\n");

for (int i = 0; i < V; i++)

printf("%d \t\t\t\t %d\n", i, dist[i]);

}

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

{

int dist[V];

bool sptSet[V

 for (int i = 0; i < V; i++)

{

dist[i] = INT_MAX, sptSet[i] = false;

}

dist[src] = 0;
```

```
for (int count = 0; count < V - 1; count++)
{
int u = minDistance(dist, sptSet,V);
sptSet[u] = true;
        for (int v = 0; v < V; v++)
if (!sptSet[v] && graph[u][v]  && dist[u] != INT_MAX && dist[u] + graph[u][v] < dist[v])
dist[v] = dist[u] + graph[u][v];
}
printSolution(dist,V);
}
void main()
{
    int n;
printf("Enter the number of vertices:\n");
scanf("%d",&n);
int graph[n][n];
printf("Enter the cost matrix of the graph:\n");
for(int i=0;i<n;i++)
{
       for(int j=0;j<n;j++)
        {
            scanf("%d",&graph[i][j]);
        }
    }
dijkstra(n,graph, 0);
}
```

10.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab>
) { .\Lab7-Dijkshtra }
Enter the number of vertices:
4
Enter the cost matrix of the graph:
0 2 3 7
2 0 6 0
3 6 0 1
7 0 1 0
Vertex          Distance from Source
0                               0
1                               2
2                               3
3                               4
```

PROGRAM 11

Implement “N-Queens Problem” using Backtracking.

11.1 CODE

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

void displayBoard(char board[][4], int n) {
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            printf("%c ", board[i][j]);
        }
        printf("\n");
    }
}
int isSafe(int row, int col, char board[][4], int n)
{
    int duprow = row;
    int dupcol = col;
    // Checking left side
    while (col >= 0)
    {
        if (board[row][col] == 'Q')
            return 0;
        col--;
    }
    row = duprow;
    col = dupcol;
    // Checking Left Upper diagonal
    while (row >= 0 && col >= 0)
```

```
    {
        if (board[row][col] == 'Q')
            return 0;
        row--;
        col--;
    }
    row = duprow;
    col = dupcol;
    // Checking Left Lower diagonal
    while (row < n && col >= 0)
    {
        if (board[row][col] == 'Q')
            return 0;
        row++;
        col--;
    }
    return 1;
}
void solve(int col, char board[][4], int n)
{
    if(col == n)
    {
        displayBoard(board,n);
        printf("\n"); //For next combination of board
        return;
    }
    for(int row =0; row<n;row++)
    {
        if(isSafe(row,col,board,n))
        {
```

```
            board[row][col] ='Q';
            solve(col+1,board,n);
            board[row][col] = '.'; //Backtracking step
        }
    }
}

int main()
{
    int n;
    printf("Enter the dimension of chessBoard:\n");
    scanf("%d", &n);
    if(n==2 || n==3)
    {
        printf("No solution exists!\n");
        exit(0);
    }
    char board[n][n];
    // Initialising board with No queen
    for (int i = 0; i < n; i++)
    {
        for (int j = 0; j < n; j++)
        {
            board[i][j] = '.';
        }
    }
    solve(0, board,n); // 0th col is called
    return 0;
}
```

11.2 OUTPUT

```
PS C:\Users\neha2\Documents\1BM21CS113_ADA_Lab>
.\Lab7-NQueens }
Enter the dimension of chessBoard:
4
. . Q .
Q . . .
. . . Q
. Q . .

. Q . .
. . . Q
Q . . .
. . Q .
```