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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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CERTIFICATE

This is to certify that the Lab work entitled “**Analysis and Design of Algorithms**” carried out by Dhavan S K (1BM21CS054), 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 traversal 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 exists 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>
hanson-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 conquer(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);
    conquer(arr,s,mid,e);
}

void main()
{
    clock_t st,et;
    double ts;

```

```

int n= rand()%100+50; // General formula 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);
}

```

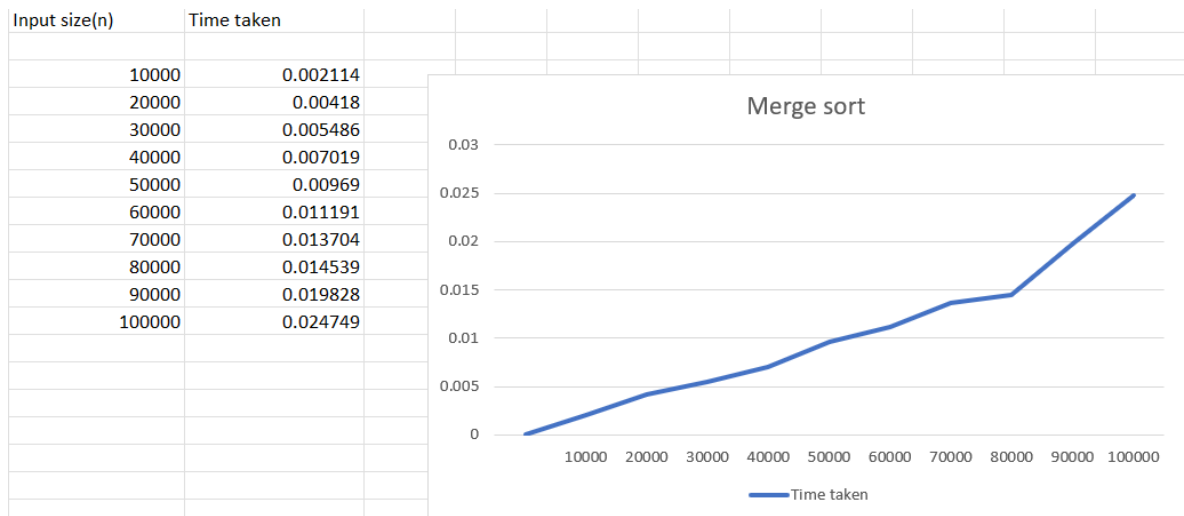
4.2 OUTPUT

```

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



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;

}

```

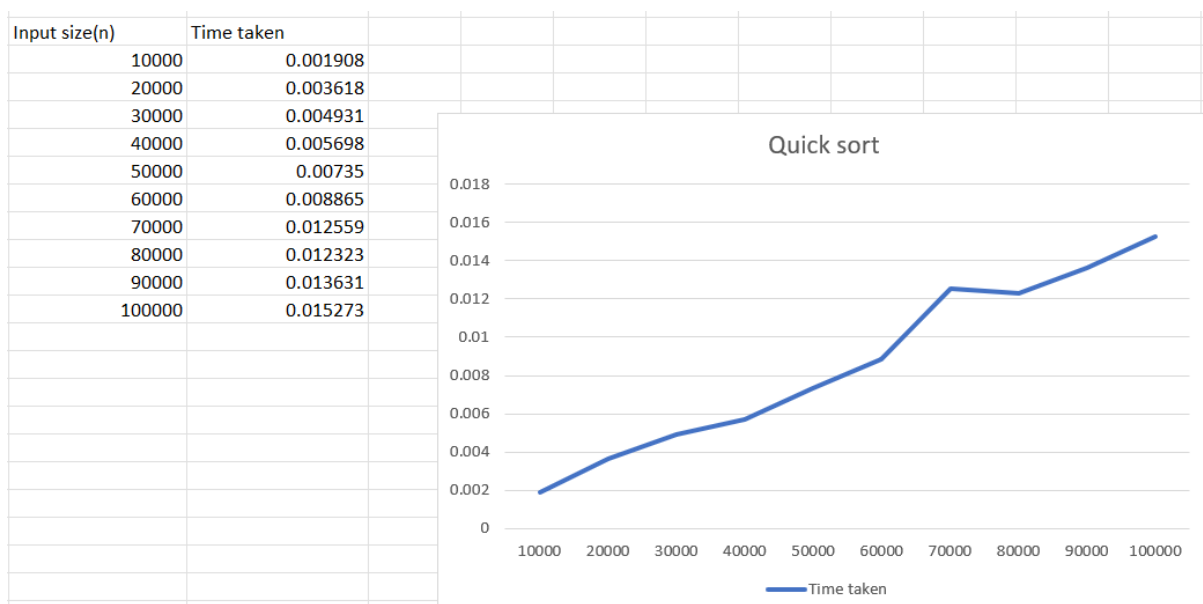
5.2 OUTPUT

```

PS C:\Users\neha2\OneDrive\Documents\ADA_practice>
.\QuickSort }
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

```

5.3 GRAPH TO SHOW TIME COMPLEXITY



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;
}

```

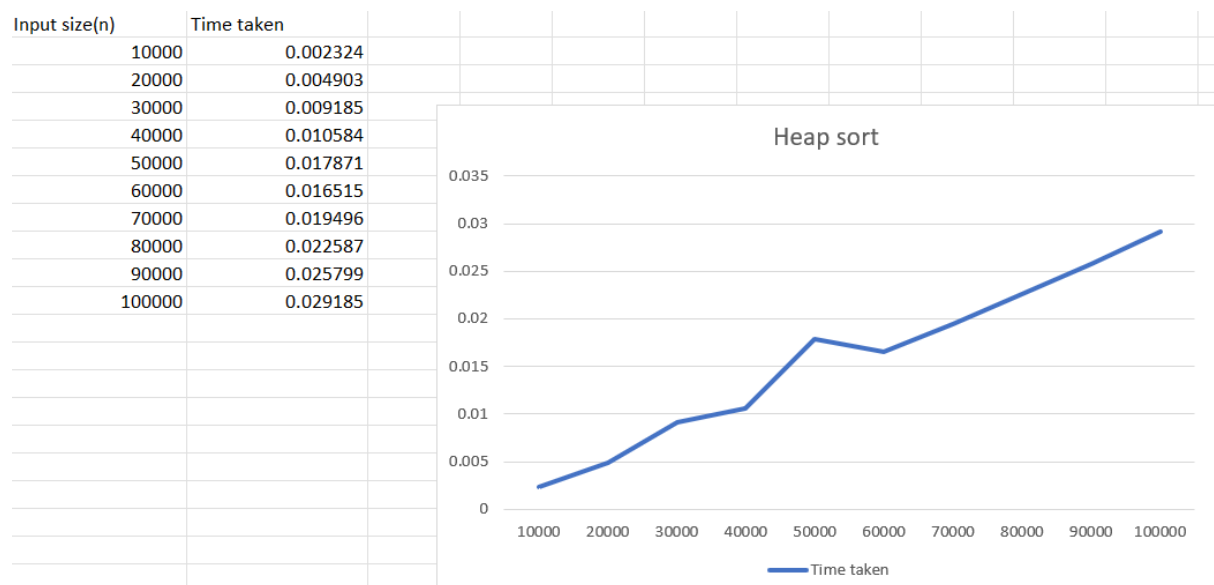
6.2 OUTPUT

```

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



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\t",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++)
    {

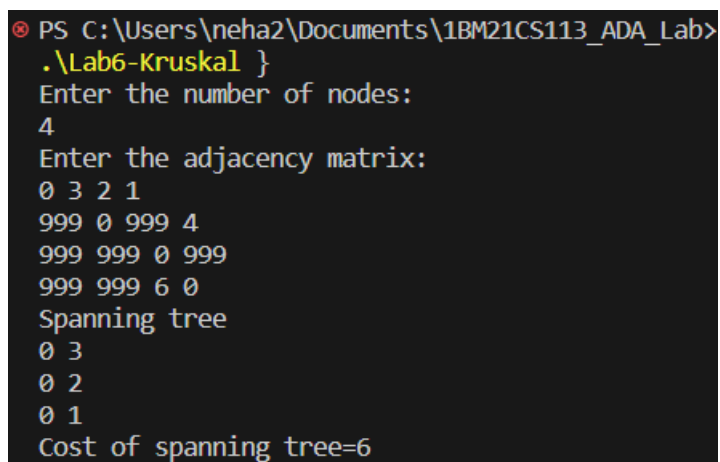
```

```

        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 %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 .
```