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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
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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 **DHIKSHA RATHIS (1BM21CS055)**, who is a 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.

EXPERIMENT 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.

a.

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

```
int a[20][20],q[20],visited[20],n,  
f=-1,r=-1;
```

```
void bfs(int v)  
{  
    int i;  
    for (i=0;i<n;i++)  
    {  
        if(a[v][i] != 0 && visited[i] == 0)  
        {  
            r=r+1;  
            q[r]=i;  
            visited[i]=1;  
            printf("%d ",i);  
        }  
    }  
    f=f+1;  
    if(f<=r)  
        bfs(q[f]);  
}
```

```
void main()  
{  
    int v,i,j;  
    printf("\nEnter the number of vertices:");  
    scanf("%d",&n);  
    for (i=0;i<n;i++)  
    {  
        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);
f=r=0;
q[r]=v;
printf("\nBFS traversal is:\n");
visited[v]=1;
printf("%d ",v);

bfs(v);
if(r != n-1)
    printf("\nBFS is not possible");
}

```

```

Enter the number of vertices:4
Enter graph data in matrix form:
1 0 1 0
0 0 1 1
1 0 1 1
0 0 0 1
Enter the starting vertex:1
BFS traversal is:
1 2 3 0

```

```

Enter the number of vertices:4
Enter graph data in matrix form:
1 0 1 0
0 0 1 1
1 0 1 1
0 0 0 1
Enter the starting vertex:1
BFS traversal is:
1 2 3 0

```

b.

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

```
int a[20][20],reach[20],n;
```

```
void dfs(int v){
```

```
    int i;
```

```
    reach[v]=1;
```

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

```
        if(a[v][i]&&!reach[i]){
```

```

        printf("\n%d->%d",v,i);
        dfs(i);
    }
}

int main(){
    int i,j,count=0;
    printf("\nEnter no of vertices : ");
    scanf("%d",&n);
    for(i=1;i<=n;i++){
        for(j=1;j<=n;j++){
            reach[i]=0;
            a[i][j]=0;
        }

        printf("\nEnter adjacency matrix : \n");
        for(i=1;i<=n;i++){
            for(j=1;j<=n;j++){
                scanf("%d",&a[i][j]);

            dfs(1);
            for(i=1;i<=n;i++){
                if(reach[i])
                    count++;
            }
            if(count==n)
                printf("\nGraph is connected.");
            else
                printf("\nGraph is disconnected.");
            return(0);

```

```

Enter no of vertices : 4
Enter adjacency matrix :
1 0 1 0
1 1 1 1
0 0 0 0
1 0 0 1
1->3
Graph is disconnected.

```

```

Enter no of vertices : 4
Enter adjacency matrix :
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
1->2
2->4
4->3
Graph is connected.

```

EXPERIMENT 2:

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

```
#include<stdio.h>
void main()
{
    int a[20][20],rem[20],ind,n,i,j,flag=0,t=0;
    printf("\nEnter the value of n ");
    scanf("%d",&n);
    printf("\nEnter the adjacency matrix ");
    for(i=0;i<n;i++)
    {
        rem[i]=0;
        for(j=0;j<n;j++)
        {
            scanf("%d",&a[i][j]);
        }
    }
    while(flag==0)
    {
        flag=1;
        for(i=0;i<n;i++)
        {
            if(rem[i]==0)
            {
                ind=0;
                for(j=0;j<n;j++)
                {
                    if(!(rem[j]==1 | a[j][i]==0))
                    {
                        ind=1;
                        break;
                    }
                }
            }
            if(ind==0)
            {
                printf("%s",t==0?"\nTopological ordering is ":"");
                rem[i]=1;
            }
        }
    }
}
```



```
        printf("%d ",i+1);
        flag=0;
        t++;
        break;
    }
}
}
}
if(t!=n)
{
    printf("\nTopological ordering is not possible(it can only be partially ordered)!!");
}
}
```

```
Enter the value of n 5
Enter the adjacency matrix
0 1 1 1 0
0 0 0 0 0
0 0 0 0 1
0 0 0 0 0
0 0 0 0 0
Topological ordering is 1 2 3 4 5
```

EXPERIMENT 3:

Implement Johnson Trotter algorithm to generate permutations.

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

bool LEFT_TO_RIGHT = true;
bool RIGHT_TO_LEFT = false;

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;
}

int getMobile(int a[], bool dir[], int n)
{
    int mobile_prev = 0, mobile = 0;
    for (int i = 0; i < n; i++) {
        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;
else
    return mobile;
}

void printOnePerm(int a[], bool dir[], int n)
{
    int mobile = getMobile(a, dir, n);
    int pos = searchArr(a, n, mobile);

    if (dir[a[pos] - 1] == RIGHT_TO_LEFT)
        swap(&a[pos - 1], &a[pos]);

    else if (dir[a[pos] - 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 fact(int n)
{
    int res = 1;
    for (int i = 1; i <= n; i++)
        res = res * i;
    return res;
}
```

```
void printPermutation(int n)
{
    int a[n];

    bool 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 < fact(n); i++)
        printOnePerm(a, dir, n);
}
```

```
int main()
{
    int n = 4;
    printPermutation(n);
    return 0;
}
```

OUTPUT:

```
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
```

EXPERIMENT 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>
#include <time.h>

void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;

    int L[n1], R[n2];

    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];

    i = 0;
    j = 0;
    k = l;
    while (i < n1 && j < n2) {
        if (L[i] <= R[j]) {
            arr[k] = L[i];
            i++;
        }
        else {
            arr[k] = R[j];
            j++;
        }
        k++;
    }
}
```

```
while (i < n1) {  
    arr[k] = L[i];  
    i++;  
    k++;  
}
```

```
while (j < n2) {  
    arr[k] = R[j];  
    j++;  
    k++;  
}  
}
```

```
void mergeSort(int arr[], int l, int r)  
{  
    if (l < r) {  
        int m = l + (r - l) / 2;  
  
        mergeSort(arr, l, m);  
        mergeSort(arr, m + 1, r);  
  
        merge(arr, l, m, r);  
    }  
}
```

```
void printArray(int A[], int size)  
{  
    int i;  
    for (i = 0; i < size; i++)  
        printf("%d ", A[i]);  
    printf("\n");  
}
```

```
int main()  
{
```

```
int arr[200], num, i;
clock_t start, end;

printf("Enter no of elements in the array\t");
scanf("%d", &num);

printf("Enter the array\n");
for (i=0;i<num;i++)
{
    arr[i] = rand();
}

printf("Given array is \t");
printArray(arr, num);

start = clock();
mergeSort(arr, 0, num - 1);
end = clock();

printf("\nSorted array is \n");
printArray(arr, num);

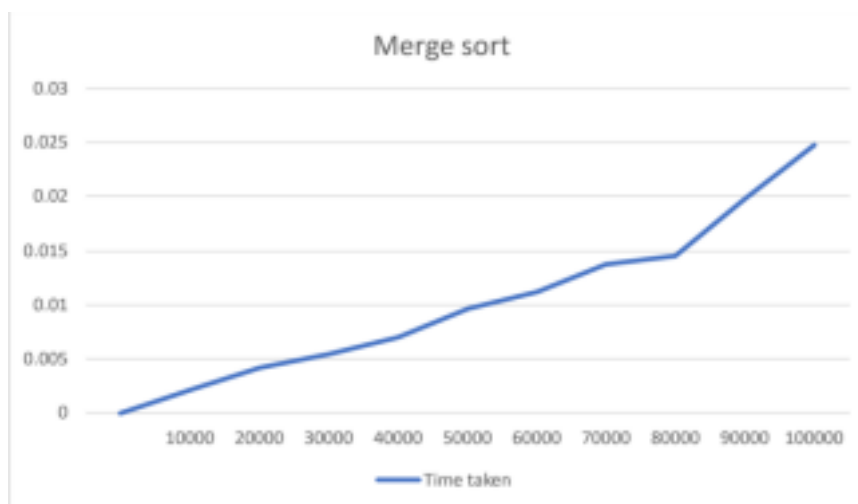
printf("Amount of time taken is: %f", ((double)(end-start))/CLOCKS_
PER_SEC);
return 0;
```


OUTPUT:

```
Enter no of elements in the array  5
Enter the array
Given array is  1804289383 846930886 1681692777 1714636915 1957747793

Sorted array is
846930886 1681692777 1714636915 1804289383 1957747793
Amount of time taken is: 0.000002
```

GRAPH:



EXPERIMENT 5:

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

```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
int partition(int a[],int low,int high)
{
    int key,i,j,temp;
    key=a[low];
    i=low+1;
    j=high;
    while(1)
    {
        while(i<high && key>=a[i])
            i++;
        while(key<a[j])
            j--;
        if(i<j)
        {
            temp=a[i];
            a[i]=a[j];
            a[j]=temp;
        }
        else
        {
            temp=a[low];
            a[low]=a[j];
            a[j]=temp;
            return j;
        }
    }
}
void quicksort(int a[],int low,int high)
{
    int j;
    if(low<high)
```

```

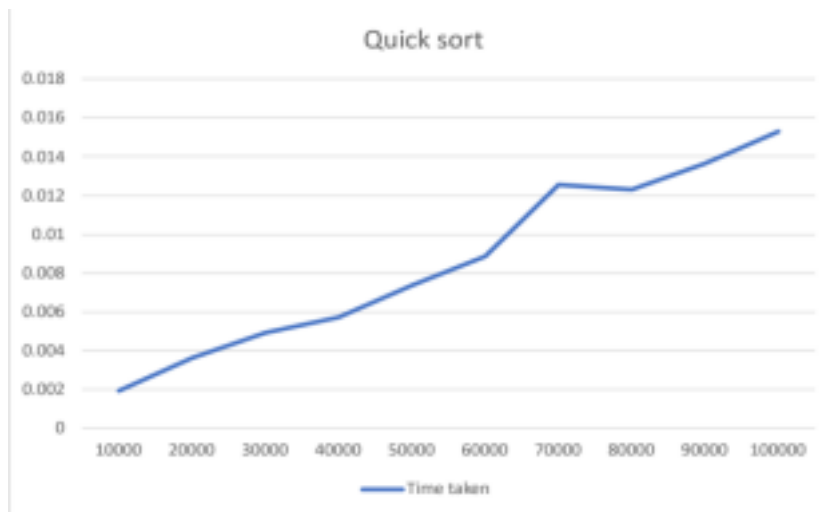
{
j=partition(a,low,high);
quicksort(a,low,j-1);
quicksort(a,j+1,high);
}
}
void main()
{
int a[10000],n,t,i;
clock_t end,start;
printf("Enter the number of array elements:\n");
scanf("%d",&n);
printf("Enter the array elements:\n");
for(i=0;i<n;i++)
{
a[i]=rand()%1000;
printf("%d\n",a[i]);
}
start=clock();
for(int j=0;j<5000000;j++)
t=900/900;
quicksort(a,0,n-1);
end=clock();
printf("Sorted array:\n");
for(i=0;i<n;i++)
{
printf("%d\n",a[i]);
}
printf("Time taken to search an given element in an array of is
%f\n",(((double)(end-start))/CLOCKS_PER_SEC));
}

```

OUTPUT:

```
Enter the number of array elements:  
5  
The array elements are:  
383 886 777 915 793  
  
Sorted array:  
383 777 793 886 915  
  
Time taken to search an given element in an array of is 0.003845
```

GRAPH:



EXPERIMENT 6:

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

```
#include <stdio.h>
#include <time.h>
clock_t start, end;

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

void heapify(int arr[], int 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) {
        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);  
}  
}
```

```
void printArray(int arr[], int N)  
{  
for (int i = 0; i < N; i++)  
    printf("%d ", arr[i]);  
    printf("\n");  
}
```

```
int main()  
{  
    int arr[1000];  
    int N;  
    printf("Enter number of elements:");  
    scanf("%d",&N);
```

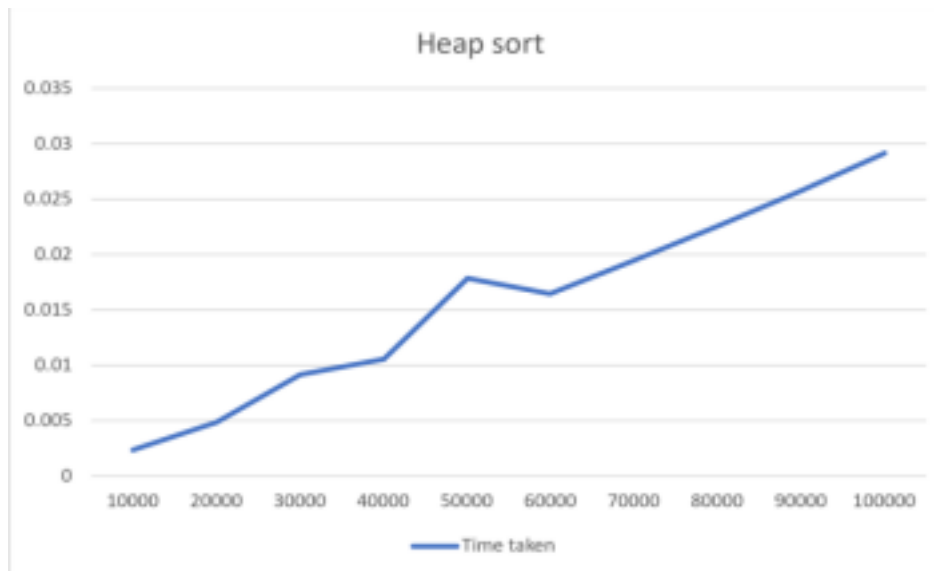
```
    printf("\nEnter elements:");  
    for (int i=0; i<N; i++)  
        {arr[i]=rand();}  
    start=clock();  
    heapSort(arr, N);  
    end=clock();  
    printf("Sorted array is\n");  
    printArray(arr, N);  
    printf("\n Time taken to sort: %f seconds",(double)(end-start)/CLOCKS_PER_SEC);  
}
```

OUTPUT:

```
Enter number of elements:5
Elements are:
1804289383  846930886   1681692777  1714636915  1957747793
Sorted array is
846930886 1681692777 1714636915 1804289383 1957747793

Time taken to sort: 0.000002 seconds|
```

GRAPH:



EXPERIMENT 7:

Implement 0/1 Knapsack problem using dynamic programming.

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

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

```
int knapSack(int W, int wt[], int val[], int n, int selected[]) {  
    int i, w;  
    int K[n + 1][W + 1];  
  
    for (i = 0; i <= n; i++) {  
        for (w = 0; w <= W; w++) {  
            if (i == 0 || w == 0)  
                K[i][w] = 0;  
            else if (wt[i - 1] <= w)  
                K[i][w] = max(val[i - 1] + K[i - 1][w - wt[i - 1]], K[i - 1][w]);  
            else  
                K[i][w] = K[i - 1][w];  
        }  
    }  
  
    int res = K[n][W];  
    w = W;  
    for (i = n; i > 0 && res > 0; i--) {  
        if (res == K[i - 1][w])  
            continue;  
        else {  
            selected[i - 1] = 1;  
            res = res - val[i - 1];  
            w = w - wt[i - 1];  
        }  
    }  
  
    return K[n][W];  
}
```



```

int main() {
    int n, W, i;
    printf("Enter the number of items: ");
    scanf("%d", &n);
    int val[n], wt[n], selected[n];
    printf("Enter the values of the items: ");
    for (i = 0; i < n; i++)
        scanf("%d", &val[i]);
    printf("Enter the weights of the items: ");
    for (i = 0; i < n; i++)
        scanf("%d", &wt[i]);
    printf("Enter the capacity of the knapsack: ");
    scanf("%d", &W);
    int max_profit = knapSack(W, wt, val, n, selected);
    printf("The maximum profit is %d\n", max_profit);
    printf("The objects selected for the optimal solution are: ");
    for (i = 0; i < n; i++) {
        if (selected[i])
            printf("%d ", i + 1);
    }
    return 0;
}

```

OUTPUT:

```

Enter the number of items: 4
Enter the values of the items: 23 65 8 12
Enter the weights of the items: 2 54 7 9
Enter the capacity of the knapsack: 65
The maximum profit is 100

```

EXPERIMENT 8:

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

```
#include<stdio.h>
#include<conio.h>
int a[10][10],n;
void floyd();
int min(int,int);
void main()
{
    int i,j;
    printf("Enter the number of vertices\n");
    scanf("%d",&n);
    printf("Enter the adjacency matrix:\n");
    for(i=1;i<=n;i++)
    {
        for(j=1;j<=n;j++)
        {
            scanf("%d",&a[i][j]);
        }
    }
    floyd();
}
void floyd()
{
    int i,j,k;
    for(k=1;k<=n;k++)
    {
        for(i=1;i<=n;i++)
        {
            for(j=1;j<=n;j++)
            {
                a[i][j]=min(a[i][j],a[i][k]+a[k][j]);
            }
        }
    }
    printf("All pair of shortest path matrix is:\n");
```

```

for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
printf("%d\t",a[i][j]);
}
printf("\n\n");
}
}
int min(int x,int y)
{
if(x<y)
return x;
else
return y;
}

```

OUTPUT:

```

Enter the number of vertices
4
Enter the adjacency matrix:
9999 9999 3 9999
2 9999 9999 9999
9999 7 9999 1
6 9999 9999 9999
9999 9999 3 9999

```

```

All pair of shortest path matrix is:
10 10 3 4
2 12 5 6
7 7 10 1
6 16 9 10

```

EXPERIMENT 9:

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

a. Prim's 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();
```

```
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;
}
}

```

OUTPUT:

```
enter the number of vertices
6
enter the cost adjacency matrix
0 3 1 6 0 0
3 0 5 0 3 0
1 5 0 5 6 4
6 0 5 0 0 2
0 3 6 0 0 6
0 0 4 2 6 0
0 3 1 6 0 0
```

```
edges of spanning tree
1,5 5,4 4,2 2,6 1,3 weight=1
```

b. Kruskal's 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");
    }
}

```

```

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);
}

```

OUTPUT:

```

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

```


EXPERIMENT 10:

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

```
#include <stdio.h>
#define INFINITY 9999
#define MAX 10

void Dijkstra(int Graph[MAX][MAX], int n, int start);

void Dijkstra(int Graph[MAX][MAX], int n, int start) {
    int cost[MAX][MAX], distance[MAX], pred[MAX];
    int visited[MAX], count, mindistance, nextnode, i, j;

    // Creating cost matrix
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            if (Graph[i][j] == 0)
                cost[i][j] = INFINITY;
            else
                cost[i][j] = Graph[i][j];

    for (i = 0; i < n; i++) {
        distance[i] = cost[start][i];
        pred[i] = start;
        visited[i] = 0;
    }

    distance[start] = 0;
    visited[start] = 1;
    count = 1;

    while (count < n - 1) {
        mindistance = INFINITY;

        for (i = 0; i < n; i++)
            if (distance[i] < mindistance && !visited[i]) {
                mindistance = distance[i];
```

```

        nextnode = i;
    }

    visited[nextnode] = 1;
    for (i = 0; i < n; i++)
        if (!visited[i])
            if (mindistance + cost[nextnode][i] < distance[i]) {
                distance[i] = mindistance + cost[nextnode][i];
                pred[i] = nextnode;
            }
    count++;
}

// Printing the distance
for (i = 0; i < n; i++)
    if (i != start) {
        printf("\nDistance from source to %d: %d", i, distance[i]);
    }
}

int main() {
    int Graph[MAX][MAX], i, j, n, u;
    printf("Enter number of nodes:");
    scanf("%d",&n);
    printf("Enter matrix:");
    for (i=0; i<n;i++)
    {
        for (j=0; j<n;j++)
        {scanf("%d",&Graph[i][j]);
        }
    }
    printf("Enter initial vertex:");
    scanf("%d",&u);
    4

    Dijkstra(Graph, n, u);

    return 0;

```

OUTPUT:

```
Enter number of nodes:5
Enter matrix:9999 3 9999 7 9999
3 9999 4 2 9999
9999 4 9999 5 6
7 2 5 9999 4
9999 9999 6 4 9999
```

```
Enter initial vertex:3
Distance from source to 0: 5
Distance from source to 1: 2
Distance from source to 2: 5
Distance from source to 4: 4
```

EXPERIMENT 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-");
        }
    }
```

```
}  
}
```

If no conflict for desired position returns 1 otherwise returns 0*/

```
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:

```
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	-	-