

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

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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 **Anagha M S (1BM21CS022)**, 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.

PROGRAM 1

Write program to do the following:

- a. Print all the nodes reachable from a given starting node in a digraph using the BFS method.
- b. Check whether a given graph is connected or not using the DFS method.

CODE:

a. BFS:

```
#include <stdio.h>

int am[100][100], q[100], visit[100], front = 1, rear = 0;

void bfs(int v,int n)
{
    int i;
    printf("%d ", v);
    visit[v] = 1;
    q[++rear] = v;

    while (front <= rear)
    {
        v = q[front++];
        for (i = 1; i <= n; i++)
        {
            if (am[v][i] && !visit[i])
            {
                printf("%d ", i);
                q[++rear] = i;
                visit[i] = 1;
            }
        }
    }
}
```

```

    }
}

int main()
{
    int i, j, n, start;
    printf("Enter the number of nodes:\n");
    scanf("%d", &n);
    printf("Enter the adjacency matrix:\n");
    for (i = 1; i <= n; i++)
    {
        visit[i] = 0;
        q[i] = 0;
        for (j = 1; j <= n; j++)
        {
            scanf("%d", &am[i][j]);
        }
    }
    printf("Enter the starting node:\n");
    scanf("%d", &start);
    printf("BFS Traversal: ");
    bfs(start, n);
    printf("\n");
    return 0;
}

```

b. DFS:

```
#include <stdio.h>

//define n 4

int am[100][100],visit[100];

void dfs(int v,int n)
{
    int i;
    printf("\n %d ",v);
    visit[v]=1;
    for(i=1;i<=n;i++)
    {
        if(am[v][i]&&!visit[i])
        {
            dfs(i,n);//printf("\n %d -> %d ",v,i);
        }
    }
}

void main()
{
    int i,j,n,start;
    printf("Enter the number of nodes:\n");
    scanf("%d",&n);
    printf("Enter the adjacency matrix:\n");
    for(i=1;i<=n;i++)
    {
        visit[i]=0;
        for(j=1;j<=n;j++)
```

```
    {  
        scanf("%d",&am[i][j]);  
    }  
}  
printf("Enter the starting node:\n");  
scanf("%d",&start);  
printf("DFS Traversal: ");  
dfs(start,n);  
}
```


OUTPUT:

BFS:

```
Enter the number of nodes:
5
Enter the adjacency matrix:
0 1 0 0 1
0 0 0 1 0
1 0 0 1 0
0 0 0 0 0
0 1 0 0 0
Enter the starting node:
3
BFS Traversal: 3 1 4 2 5

Process returned 0 (0x0)   execution time : 36.640 s
Press any key to continue.
```

```
"C:\Users\HP\Desktop\BMSCI" x + v
Enter the number of nodes:
4
Enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
Enter the starting node:
1
BFS Traversal: 1 2 3 4

Process returned 0 (0x0)   execution time : 18.382 s
Press any key to continue.
```

DFS :

```
Enter the number of nodes:
5
Enter the adjacency matrix:
0 1 0 0 1
0 0 0 1 0
1 0 0 1 0
0 0 0 0 0
0 1 0 0 0
Enter the starting node:
3
DFS Traversal:
3
1
2
4
5
Process returned 6 (0x6)   execution time : 30.592 s
Press any key to continue.
```

```
"C:\Users\HP\Desktop\BMSCI" × + v
Enter the number of nodes:
4
Enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
Enter the starting node:
1
DFS Traversal:
1
2
4
3
Process returned 5 (0x5)   execution time : 21.642 s
Press any key to continue.
```

PROGRAM 2

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

CODE:

```
#include <stdio.h>

#define max 100

int visit[max],stack[max],top=-1;

void dfs(int v,int n,int am[max][max])
{
    int i;
    //printf("\n %d ",v);
    visit[v]=1;
    for(i=1;i<=n;i++)
    {
        if(am[v][i]&&!visit[i])
        {
            dfs(i,n,am);//printf("\n %d -> %d ",v,i);
        }
    }
    stack[++(top)] = v;
}

void topologicalSort(int n,int am[max][max])
{
    int i,j;
    for (i = 1; i <=n ; i++)
    {
```

```

        if (!visit[i])//if not visited
            dfs(i, n, am);
    }
    printf("Topological Sort Order: ");
    while (top >= 0)
    {
        printf("%d ", stack[top--]);
    }
}

void main()
{
    int am[max][max];
    int i,j,n;
    printf("Enter the number of nodes:\n");
    scanf("%d",&n);
    printf("Enter the adjacency matrix:\n");
    for(i=1;i<=n;i++)
    {
        visit[i]=0;
        for(j=1;j<=n;j++)
        {
            scanf("%d",&am[i][j]);
        }
    }
    topologicalSort(n,am);
}

```

OUTPUT:

```
Enter the number of nodes:
5
Enter the adjacency matrix:
0 0 1 0 0
0 0 1 0 0
0 0 0 1 1
0 0 0 0 1
0 0 0 0 0
Topological Sort Order: 2 1 3 4 5
Process returned -1 (0xFFFFFFFF)   execution time : 25.425 s
Press any key to continue.
```

```
"C:\Users\HP\Desktop\BMSCI" x + v
Enter the number of nodes:
4
Enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
Topological Sort Order: 1 2 4 3
Process returned -1 (0xFFFFFFFF)   execution time : 17.707 s
Press any key to continue.
|
```

PROGRAM 3

Implement Johnson Trotter algorithm to generate permutations.

CODE:

```
#include<stdio.h>
#include<stdlib.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 searchArray(int array[], int n, int mobile)
{
    for (int i = 0; i < n; i++)
    {
        if (array[i] == mobile)
            return i + 1;
    }
    return -1; // Mobile not found
}

int getMobile(int array[], 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[array[i] - 1] == RIGHT_TO_LEFT && i != 0)
    {
        if (array[i] > array[i - 1] && array[i] > mobile_prev)
        {
            mobile = array[i];
            mobile_prev = mobile;
        }
    }
    if (dir[array[i] - 1] == LEFT_TO_RIGHT && i != n - 1)
    {
        if (array[i] > array[i + 1] && array[i] > mobile_prev)
        {
            mobile = array[i];
            mobile_prev = mobile;
        }
    }
}
if (mobile == 0 && mobile_prev == 0)
    return 0; // No mobile element found
else
    return mobile;
}

```

```

void printOnePermutation(int array[], int dir[], int n, int pnum)
{
    int mobile = getMobile(array, dir, n);

```

```

int pos = searchArray(array, n, mobile);
if (dir[array[pos - 1] - 1] == RIGHT_TO_LEFT)
    swap(&array[pos - 1], &array[pos - 2]);
else if (dir[array[pos - 1] - 1] == LEFT_TO_RIGHT)
    swap(&array[pos], &array[pos - 1]);

for (int i = 0; i < n; i++)
{
    if (array[i] > mobile)
    {
        if (dir[array[i] - 1] == LEFT_TO_RIGHT)
            dir[array[i] - 1] = RIGHT_TO_LEFT;
        else if (dir[array[i] - 1] == RIGHT_TO_LEFT)
            dir[array[i] - 1] = LEFT_TO_RIGHT;
    }
}

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

int factorial(int n)
{
    int result = 1;
    for (int i = 1; i <= n; i++)
    {
        result *= i;
    }
    return result;
}

```



```

void printPermutation(int n)
{
    int array[n],dir[n];
    printf("%d Permutations are:\n",factorial(n));
    for (int i = 0; i < n; i++)
    {
        array[i] = i + 1;
        printf(" %d ", array[i]);
    }
    printf("\n");

    for (int i = 0; i < n; i++)
    {
        dir[i] = RIGHT_TO_LEFT;//initialize right to left for all
    }
    for (int i = 1; i < factorial(n); i++)
    {
        printOnePermutation(array, dir, n,i);
    }
}

void main()
{
    int n;
    printf("Enter the value of n: ");
    scanf("%d", &n);
    printPermutation(n);
}

```

OUTPUT:

```
Enter the value of n: 4
24 Permutations are:
1 2 3 4
1 2 4 3
1 4 2 3
4 1 2 3
4 1 3 2
1 4 3 2
1 3 4 2
1 3 2 4
3 1 2 4
3 1 4 2
3 4 1 2
4 3 1 2
4 3 2 1
3 4 2 1
3 2 4 1
3 2 1 4
2 3 1 4
2 3 4 1
2 4 3 1
4 2 3 1
4 2 1 3
2 4 1 3
2 1 4 3
2 1 3 4

Process returned 0 (0x0)   execution time : 8.381 s
Press any key to continue.
```

```
"C:\Users\HP\Desktop\BMSCI" x + v
Enter the value of n: 3
6 Permutations are:
1 2 3
1 3 2
3 1 2
3 2 1
2 3 1
2 1 3

Process returned 0 (0x0)   execution time : 1.278 s
Press any key to continue.
```

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.

CODE:

```
#include<stdio.h>

void merge_sort(int low,int high,int n,int array[n])
{
    int mid;
    if(low<high)
    {
        mid=(low+high)/2;
        merge_sort(low,mid,n,array);
        merge_sort(mid+1,high,n,array);
        merge(low,mid,high,n,array);
    }
}

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

```

        i++;
        k++;
    }
    else
    {
        c[k]=array[j];
        j++;
        k++;
    }
}
while(i<=mid)
{
    c[k]=array[i];
    i++;
    k++;
}
while(j<=high)
{
    c[k]=array[j];
    j++;
    k++;
}
for (i = low; i <= high; i++)
{
    array[i]=c[i];
}
}

```

```

void main()

```

```

{
    int i;
    int array[20],n;
    printf("Enter the number of elements\n");
    scanf("%d",&n);
    printf("Enter the elements of the array\n");
    for (i = 0; i < n; i++)
    {
        scanf("%d", &array[i]);
    }
    merge_sort(0,n-1,n,array);
    printf("Sorted array is ");
    for (i = 0; i < n; i++)
    {
        // array[i]=c[i];
        printf("%d ", array[i]);
    }
}

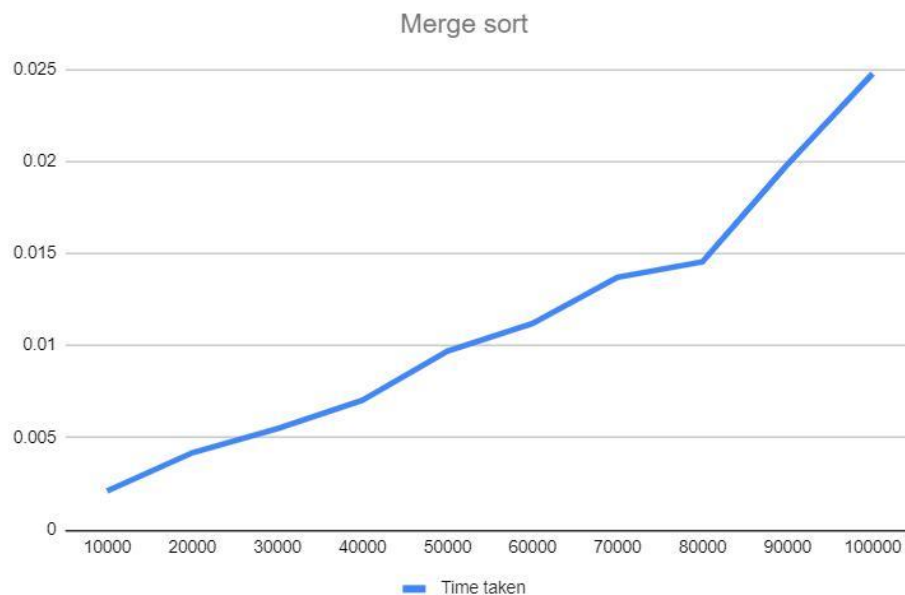
```

OUTPUT:

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

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

GRAPH:



PROGRAM 5

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

CODE:

```
#include<stdio.h>

void main()
{
    int arr[20],low,high,n,i;
    printf("Enter the number of elements in
    array\n"); scanf("%d",&n);
    printf("Enter the elements of array\n");
    for(i=0;i<n;i++)
        scanf("%d",&arr[i]);
    low=0;high=n-1;
    quickSort(low, high, arr);
    printf("Sorted array: ");
    for(i=0;i<n;i++)
        printf("%d ",arr[i]);
}

void quickSort(int low,int high,int a[])
{
    int j;
    if(low<high)
    {
        j=partition(low,high,a);
        quickSort(low,j-1,a);
        quickSort(j+1,high,a);
    }
}
```

```

    }
}

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

```

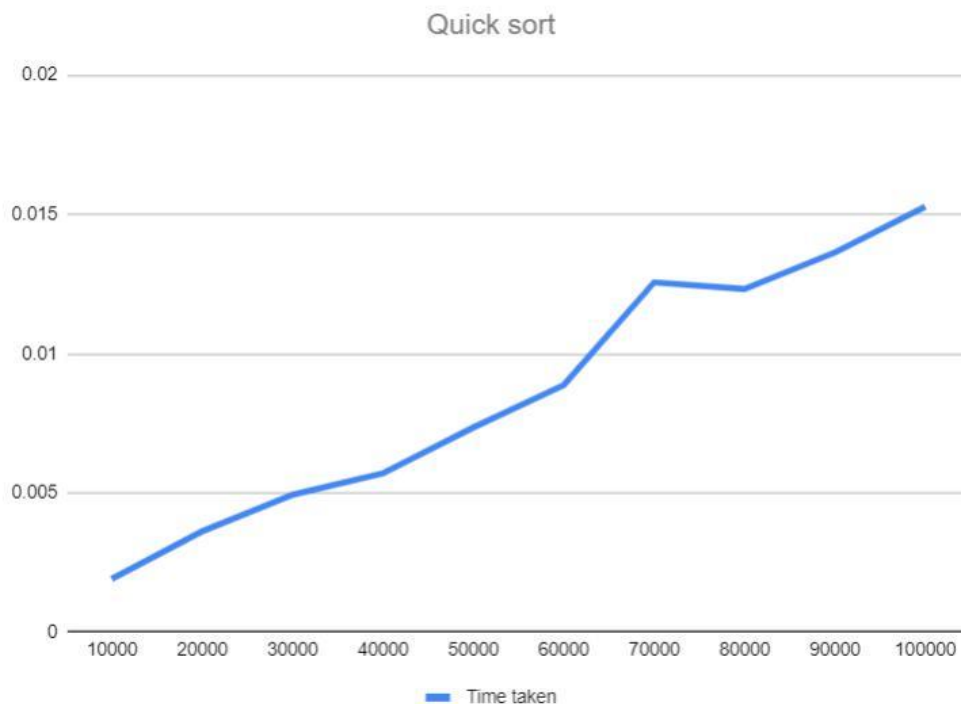

}

OUTPUT:

```
Enter the number of elements in array
9
Enter the elements of array
54 26 93 17 77 31 44 55 20
Sorted array: 17 20 26 31 44 54 55 77 93
Process returned 9 (0x9)   execution time : 97.035 s
Press any key to continue.
```

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

GRAPH:



PROGRAM 6

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

CODE:

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

```
void heapsort(int n, int arr[])
```

```
{
    for (int i = n / 2 - 1; i >= 0; i--)
        heapify(n,arr,i);
    for (int i = n - 1; i > 0; i--)
    {
        swap(&arr[0], &arr[i]);
        heapify(i, arr, 0);
    }
}
```

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

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

void main()
{
    int n;
    printf("HEAP SORT \n ");
    printf("\nEnter the number of elements to be sorted: ");
    scanf("%d", &n);
    int arr[n];
    printf("\nEnter the elements: ");
    for (int i = 0; i < n; i++)
        scanf("%d", &arr[i]);
    heapsort(n, arr);
    printf("\nSorted array in ascending order:\n ");
    for (int i = 0; i < n; i++)
        printf("%d ", arr[i]);
}

```

OUTPUT:

```
HEAP SORT

Enter the number of elements to be sorted: 5

Enter the elements: 59 32 12 67 34

Sorted array in ascending order:
12 32 34 59 67
Process returned 5 (0x5)   execution time : 9.608 s
Press any key to continue.
```

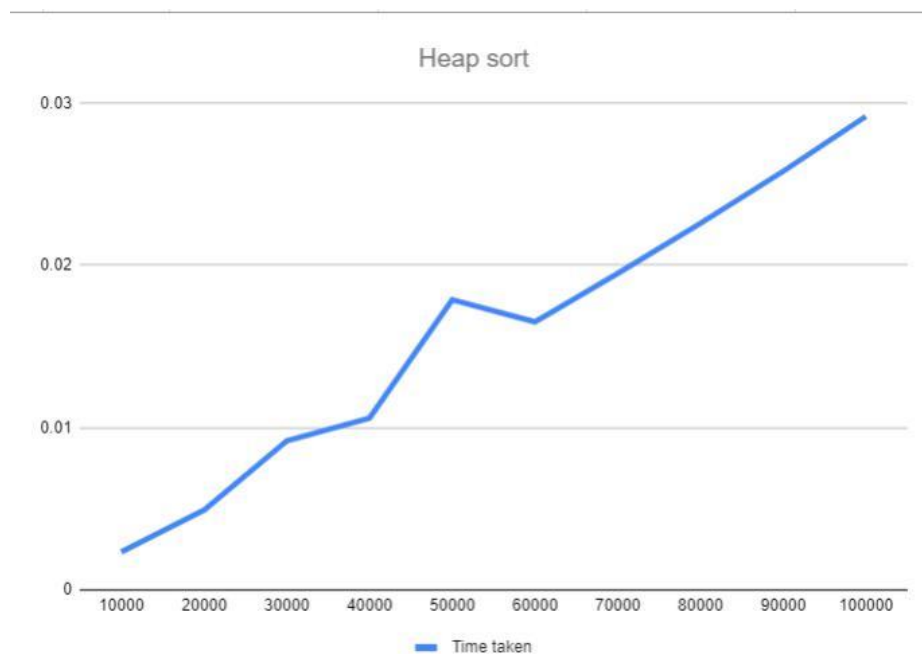
```
"C:\Users\Admin\Desktop\1BM21CS048\Sem4\ADA Lab\heap_ggg.exe"
HEAP SORT

Enter the number of elements to be sorted: 8

Enter the elements: 89 81 74 22 14 9 54 11

Sorted array in ascending order: 9 11 14 22 54 74 81 89
Process returned 8 (0x8)   execution time : 15.018 s
Press any key to continue.
```

GRAPH :



PROGRAM 7

Implement 0/1 Knapsack problem using dynamic programming.

CODE:

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

int p[15],w[15],maxW;
void main(){
    int n,i,j,maxP;
    printf("Enter the number of items\n");
    scanf("%d",&n);
    printf("Enter the max weight\n");
    scanf("%d",&maxW);
    printf("Enter the weights\n");
    for(i=0;i<n;i++)
        scanf("%d",&w[i]);
    printf("Enter the profits\n");
    for(i=0;i<n;i++)
        scanf("%d",&p[i]);
    maxP=knapsack(n);
    printf("Optimal profit is %d ",maxP);
}

int knapsack(int n) {
```

```

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

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

```

```

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

```

```

while (i > 0 && j > 0) {
    if (v[i][j] != v[i - 1][j]) {
        selected[count++] = i;
        j -= w[i - 1];
        i--;
    } else
        { i--;
        }
}

```

```

printf("TABLE \n");
for (int i = 0; i <= n; i++) {

```

```

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

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

```

OUTPUT:

```

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

```

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


PROGRAM 8

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

CODE:

```
#include<stdio.h>

#define MAX 10
#define INF 999

void printSolution(int n,int dist[MAX][MAX])
{
    printf("The following matrix shows the shortest distances between every pair of vertices \n");
    for (int i = 1; i <= n; i++)
    {
        for (int j = 1; j <= n; j++)
        {
            if (dist[i][j] == INF)
                printf("%7s", "INF");
            else
                printf("%7d ", dist[i][j]);
        }
        printf("\n");
    }
}

void floyd(int n,int dist[MAX][MAX])
{
    int i, j, k;
```

```

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

```

```

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

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

```

OUTPUT:

```
Enter the number of nodes: 4
Enter the weight matrix:
0 1 999 4
999 0 999 999
8 2 0 999
999 6 5 0
The following matrix shows the shortest distances between every pair of vertices
  0      1      9      4
INF     0    INF    INF
  8      2      0     12
 13      6      5      0
Process returned 5 (0x5)   execution time : 6.113 s
Press any key to continue.
```

```
1 #include<stdio.h>
F:\ADA\lab\floyds.exe
Enter the number of nodes: 5
Enter the weight matrix:
0 5 999 6 999
5 0 1 3 999
999 1 0 4 6
6 3 4 0 2
999 999 6 2 0
The following matrix shows the shortest distances between every pair of vertices
  0      5      6      6      8
  5      0      1      3      5
  6      1      0      4      6
  6      3      4      0      2
  8      5      6      2      0
Process returned 6 (0x6)   execution time : 384.684 s
Press any key to continue.
```

PROGRAM 9

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

KRUSKALS ALGORITHM

CODE:

```
#include<stdio.h>
#include <stdbool.h>
#define INT_MAX 999
#define V 10
int n;
int parent[V];
int find(int i)
{
    while (parent[i] != i)
        i = parent[i];
    return i;
}

void merge1(int i, int j)
{
    int a = find(i);
    int b = find(j);
    parent[a] = b;
}

void kruskalMST(int cost[][V])
{
    int mincost = 0; // Cost of min MST.
```

```

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

int edge_count = 0;
while (edge_count < n - 1)
{
    int min = INT_MAX, a = -1, b = -1;
    for (int i = 0; i < n; i++)
    {
        for (int j = 0; j < n; j++)
        {
            if (find(i) != find(j) && cost[i][j] < min)
            {
                min = cost[i][j];
                a = i;
                b = j;
            }
        }
    }
    merge1(a, b);
    printf("Edge %d:(%d, %d) cost:%d \n",
           edge_count++, a, b, min);
    mincost += min;
}

printf("\n Minimum weight= %d \n", mincost);
}

int main()
{

```

```

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

```

OUTPUT:

```

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

Minimum weight= 11

Process returned 0 (0x0)   execution time : 42.761 s
Press any key to continue.

```

```

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

Minimum weight= 5

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

```

PRIMS ALGORITHM

CODE:

```

#include <limits.h>
#include <stdbool.h>
#include <stdio.h>
#define V 10

int minKey(int key[], bool mstSet[], int n)
{
    int min = INT_MAX, min_index;

    for (int v = 0; v < n; v++)
        if (mstSet[v] == false && key[v] < min)
            min = key[v], min_index = v;
}

```

```

    return min_index;
}

int printMST(int parent[], int graph[V][V], int n)
{
    int sum=0;
    printf("Edge \tWeight\n");
    for (int i = 1; i < n; i++)
    {
        sum+=graph[i][parent[i]];
        printf("%d - %d \t%d \n", parent[i], i,
graph[i][parent[i]]);
    }
    printf("Minimum Weight = %d \n",sum);
}

void MSTPrims(int graph[V][V],int n)
{
    int parent[V];
    int key[V];
    bool mstSet[V];//stores node included in mst

    for (int i = 0; i < n; i++)
        key[i] = INT_MAX, mstSet[i] = false;//all key set to infinte and all nodes not added

    key[0] = 0;//Make key 0 so that this vertex is picked as
    first parent[0] = -1;

```



```

for (int count = 0; count < n - 1; count++)
{
    int u = minKey(key, mstSet, n); // stores min
    index mstSet[u] = true;

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

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

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

```

OUTPUT:

```
Enter the number of nodes
6
Enter the weight matrix
0 3 0 0 6 5
3 0 1 0 0 4
0 1 0 6 0 4
0 0 6 0 8 5
6 0 0 8 0 2
5 4 4 5 2 0
Edge    Weight
0 - 1    3
1 - 2    1
5 - 3    5
5 - 4    2
1 - 5    4
Minimum Weight = 15

Process returned 0 (0x0)   execution time : 32.652 s
Press any key to continue.
```

```
"C:\Users\HP\Desktop\BMSCI" x + v
Enter the number of nodes
4
Enter the weight matrix
0 5 8 0
5 0 10 15
8 10 0 20
0 15 20 0
Edge    Weight
0 - 1    5
0 - 2    8
1 - 3    15
Minimum Weight = 28

Process returned 0 (0x0)   execution time : 21.201 s
Press any key to continue.
```

PROGRAM 10

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

CODE:

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

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

    for (int v = 0; v < V; v++)
    {
        if (picked[v] == false && totalWeight[v] <= min)
        {
            min = totalWeight[v];
            min_index = v;
        }
    }

    return min_index;
}
```

```

void printPath(int currentVertex,int parents[V])
{
    if (currentVertex == noParent)
    {
        return;
    }
    printPath(parents[currentVertex], parents);
    printf("%d ",currentVertex);
}

void printSolution(int totalWeight[])
{
    printf("\nVertex \t\t Distance from
    Source\t\tPath\n"); for (int i = 0; i < V; i++)
    {
        printf("%d \t\t\t\t %d \t\t", i, totalWeight[i]);
        printPath(i,parents); //for each node we print the shortest from from root
        node printf("\n");
    }
}

void dijkstra(int graph[V][V], int src)
{
    int totalWeight[V]; //total weight from source to each node

    bool picked[V]; //node picked or not
    for (int i = 0; i < V; i++)
    {
        totalWeight[i] = MAX;
        picked[i] = false;
    }
}

```

```

    }

    totalWeight[src] = 0;
    parents[0]=noParent;//no parent yet
    for (int count = 0; count < V - 1; count++)
    {
        int u = minDistance(totalWeight, picked);//find node with min distance

        picked[u] = true;//pick that node

        for (int v = 0; v < V; v++)
        {
            if (!picked[v] && graph[u][v]
                && totalWeight[u] != MAX
                && totalWeight[u] + graph[u][v] < totalWeight[v])//find min one
            {
                totalWeight[v] = totalWeight[u] + graph[u][v];
                parents[v]=u;//u is parent of v
            }
        }
    }

    printSolution(totalWeight);
}

int main()
{
    printf("Enter the number of Vertices of the
    graph:\n"); scanf("%d",&V);

```

```

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

    dijkstra(graph, 0);

    return 0;
}

```

OUTPUT:

```

Enter the number of Vertices of the graph:
6
Enter the matrix
0 25 35 999 100 999
999 0 27 14 999 999
999 999 0 29 999 999
999 999 999 0 999 21
999 999 50 999 0 999
999 999 999 999 48 0

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

Process returned 0 (0x0)   execution time : 6.111 s
Press any key to continue.

```

Enter the number of vertices

5

Enter the matrix

0 5 999 6 999

5 0 1 3 999

999 1 0 4 6

6 3 4 0 2

999 999 6 2 0

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

Process returned 0 (0x0) execution time : 40.973 s

Press any key to continue.

PROGRAM 11

Implement “N-Queens Problem” using Backtracking

CODE:

```
#include <stdio.h>

#define MAX 10

int x[MAX],c=0;

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

void write(int n)
{
    c++;
    printf("\nSolution %d: \n\n",c);
    for (int i = 1; i <= n; i++)//i-> queen number
    {
        for (int j = 1; j <= n; j++)//j-> position
        {
            if (j == x[i])
```



```

        printf("Q%d\t",i);
    else
        printf("_\t");
    }
    printf("\n\n");
}
printf("\n");
}

```

```

void nqueens(int n)
{
    int k = 1; //Select the first queen
    x[k] = 0; //But not placed on chess board

    while (k != 0) //A queen exists ?
    {
        x[k] = x[k] + 1; //Place the kth queen in next column

        while (x[k] <= n && !place(k))
        {
            x[k] = x[k] + 1;
        }
        if (x[k] <= n)
        {
            if (k == n) //If all Queens are placed
            {
                write(n);
            }
            else

```

```

        {
            k = k + 1; //Select next Queen
            x[k] = 0; //But do not place
        }
    }
else
    k = k - 1; //Backtrack and select previous queen
}
}

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

```

OUTPUT:

```

Enter the value of N: 4
Solution 1:
_      Q1      _      _
_      _      _      Q2
Q3      _      _      _
_      _      Q4      _

Solution 2:
_      _      Q1      _
Q2      _      _      _
_      _      _      Q3
_      Q4      _      _

Process returned 0 (0x0)   execution time : 1.264 s
Press any key to continue.

```

92 solutions for n=8

Enter the value of N: 8

Solution 1:

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

Solution 2:

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