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“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

(Autonomous Institution under VTU)

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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 **B VENKATESH (1BM22CS404)**, 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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Index Sheet

Lab Program No.	Program Details	Page No.
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.	5-11
2	Write program to obtain the Topological ordering of vertices in a given digraph.	12-14
3	Implement Johnson Trotter algorithm to generate permutations.	15-20
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.	21-24
5	Sort a given set of N integer elements using Quick Sort technique and compute its time taken.	25-29
6	Sort a given set of N integer elements using Heap Sort technique and compute its time taken.	30-35
7	Implement 0/1 Knapsack problem using dynamic programming.	36-40
8	Implement All Pair Shortest paths problem using Floyd's algorithm.	41-44
9	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's and Kruskal's algorithm.	45-51
10	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.	52-55
11	Implement "N-Queens Problem" using Backtracking.	56-59

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.

LAB PROGRAM-01

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. BFS:-

```
#include<stdio.h>

#include<conio.h>

int a[10][10],n;

void bfs(int);

void main()

{

    int i,j,src;

    printf("\n enter the no of nodes:\t");

    scanf("%d",&n);

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

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

    {

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

        {

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

        }

    }

}
```

```
printf("\n enter the source node:\n");
```

```
scanf("%d",&src);
```

```
bfs(src);
```

```
}
```

```
void bfs(int src)
```

```
{
```

```
int q[10],f=0,r=-1,vis[10],i,j;
```

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

```
{
```

```
vis[j]=0;
```

```
}
```

```
vis[src]=1;
```

```
r=r+1;
```

```
q[r]=src;
```

```
while(f<+r)
```

```
{
```

```
i=q[f];
```

```
f=f+1;
```

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

```
{
```

```
if(a[i][j]==1&&vis[j]!=1)
```

```
{
```

```
vis[j]=1;
```

```

r=r+1;
q[r]=j;
}
}
}
for(j=1;j<=n;j++)
{

if(vis[j]!=1)
printf("\n node %d is not reachable\n",j);
else
printf("\n node %d is reachable\n",j);
}
}

```

OUTPUT:-



```

C:\Users\Admin\Desktop\1bmcs22\bfs.exe

enter the no of nodes: 4
enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 1
0 0 0 0

enter the source node:
1

node 1 is reachable
node 2 is not reachable
node 3 is not reachable
node 4 is not reachable

Process returned 4 (0x4)   execution time : 17.766 s
Press any key to continue.

```

```
C:\Users\Admin\Desktop\415\bfs.exe

enter the no of nodes: 4
enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 1
0 0 0 0

enter the source node:
1

node 1 is reachable
node 2 is reachable
node 3 is reachable
node 4 is reachable

Process returned 4 (0x4)    execution time : 32.241 s
Press any key to continue.
```

b. DFS:-

```
#include<stdio.h>
#include<conio.h>
int a[10][10],n,vis[10];
int dfs(int);
void main()
{
    int i,j,src,ans;
    for(j=1;j<=n;j++)
    {
        vis[j]=0;
    }
    printf("\nenter the no of nodes:\t");
    scanf("%d",&n);
    printf("\nenter the adjacency matrix:\n");
```



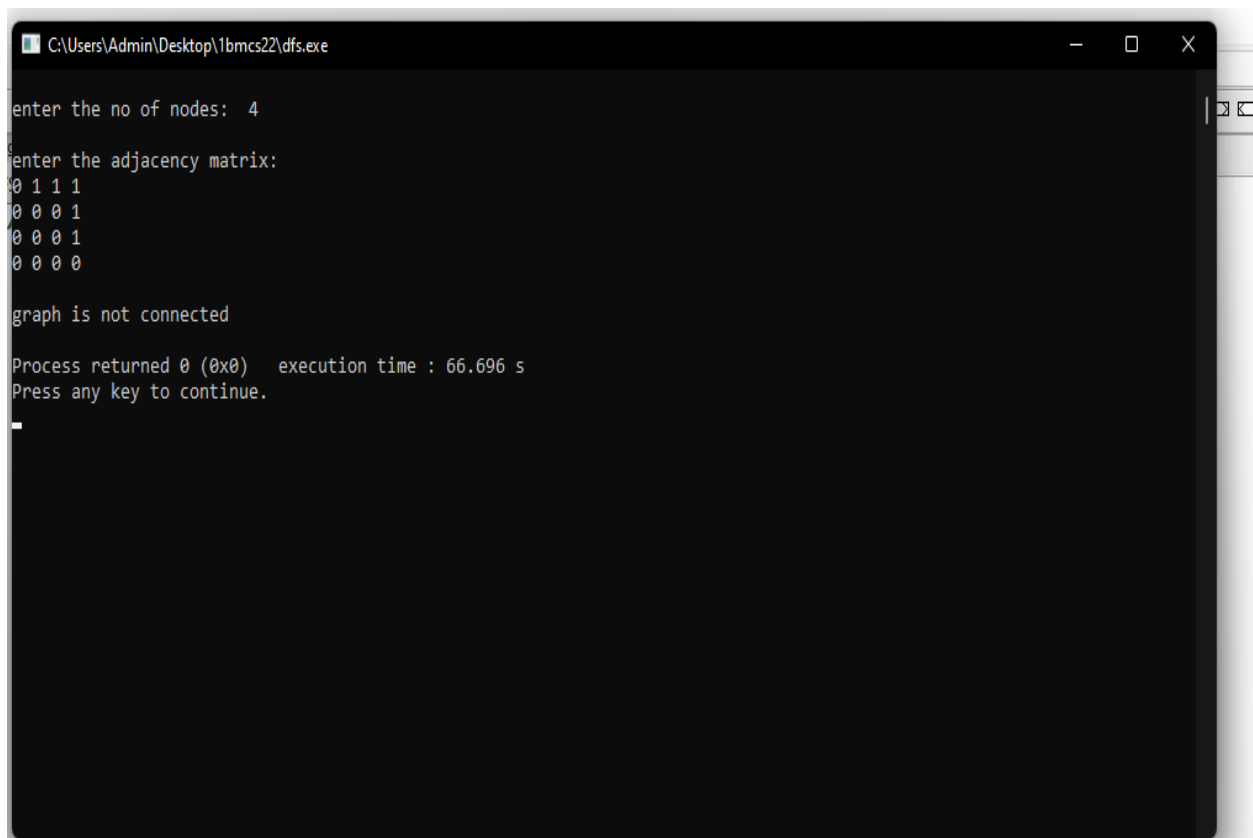
```
for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
scanf("%d",&a[i][j]);
}
}

ans=dfs(src);
if(ans==1)
{
printf("\ngraph is connected\n");
}
else
{
printf("\ngraph is not connected\n");
}
}

int dfs(int src)
{
int j;
vis[src]=1;
for(j=1;j<n;j++)
{
if(a[src][j]==1 && vis[j]!=1)
```

```
dfs(j);  
}  
for(j=1;j<=n;j++)  
{  
if(vis[j]!=1)  
return 0;  
}  
return 1;  
}
```

OUTPUT:-



```
C:\Users\Admin\Desktop\1bmcs22\dfs.exe  
enter the no of nodes: 4  
enter the adjacency matrix:  
0 1 1 1  
0 0 0 1  
0 0 0 1  
0 0 0 0  
  
graph is not connected  
  
Process returned 0 (0x0)   execution time : 66.696 s  
Press any key to continue.  
-
```

```
"C:\Users\kavan\OneDrive\De  X + v

enter the no of nodes: 4

enter the adjacency matrix:
0 1 1 0
0 0 0 1
0 0 0 1
0 0 0 1

enter the source node: 2

graph is not connected

Process returned 0 (0x0)  execution time : 18.706 s
Press any key to continue.
|
```

LAB PROGRAM-02

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

```
#include<stdio.h>
#include<conio.h>
void source_removal(int n,int a[10][10])
{
    int i,j,k,u,v,top,s[10],t[10],indeg[10],sum;
    for(i=0;i<n;i++)
    {
        sum=0;
        for(j=0;j<n;j++)
            sum=sum+a[j][i];
        indeg[i]=sum;
    }
    top=-1;
    for(i=0;i<n;i++)
    {
        if(indeg[i]==0)
            s[++top]=i;
    }
    k=0;
    while(top!=-1)
    {
        u=s[top--];
        t[k++]=u;
```

```

for(v=0;v<n;v++)
{
if(a[u][v]==1)
{
indeg[v]=indeg[v]-1;
if(indeg[v]==0)
s[++top]=v;
}
}
}
for(i=0;i<n;i++)
{
printf("%d\n",t[i]);
}
}

void main()
{
int i,j,a[10][10],n;
printf("Enter 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]);

```

```

}
source_removal(n,a);
}

```

OUTPUT:-

```

C:\Users\Admin\Desktop\1bmcs22\topological.exe
Enter number of nodes:
4
Enter the adjacency matrix
0 1 1 1
0 0 0 1
0 0 0 1
0 0 0 0
0
2
1
3
Process returned 4 (0x4) execution time : 33.044 s
Press any key to continue.

```

```

"C:\Users\kavan\OneDrive\De
Enter number of nodes:
4
Enter the adjacency matrix
0 1 1 0
0 0 1 1
0 0 0 1
0 0 0 1
0
1
2
0
Process returned 4 (0x4) execution time : 33.044 s
Press any key to continue.

```

LAB PROGRAM-03

Implement Johnson Trotter algorithm to generate permutations.

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

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

```
int swap(int *a,int *b)
```

```
{
```

```
int t = *a;
```

```
*a = *b;
```

```
*b = t;
```

```
}
```

```
int search(int arr[],int num,int mobile)
```

```
{
```

```
int g;
```

```
for(g=0;g<num;g++)
```

```
{
```

```
if(arr[g] == mobile)
```

```
{
```

```
return g;
```

```
}
```

```
}
```

```
return -1;
```

```
}
```

```
int find_Moblie(int arr[],int d[],int num)
```

```
{
```

```
int mobile = 0;

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

{
if((d[arr[i]-1] == 0) && i != 0)
{
if(arr[i]>arr[i-1] && arr[i]>mobile)
{
mobile = arr[i];

}

}
else if((d[arr[i]-1] == 1) & i != num-1)
{
if(arr[i]>arr[i+1] && arr[i]>mobile)
{
mobile = arr[i];
}
}
}

if(mobile == 0)
return 0;
```



```

else
return mobile;
}

void permutations(int arr[],int d[],int num)
{
int i;
int mobile = find_Moblie(arr,d,num);
int pos = search(arr,num,mobile);
if(d[arr[pos]-1]==0)
swap(&arr[pos],&arr[pos-1]);
else
swap(&arr[pos],&arr[pos+1]);
for(int i=0;i<num;i++)
{
if(arr[i] > mobile)
{
if(d[arr[i]-1]==0)
d[arr[i]-1] = 1;
else
d[arr[i]-1] = 0;
}
}
for(i=0;i<num;i++)
{
printf(" %d ",arr[i]);

```

```
}  
}
```

```
int factorial(int k)
```

```
{
```

```
int f = 1;
```

```
int i = 0;
```

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

```
{
```

```
f = f*i;
```

```
}
```

```
return f;
```

```
}
```

```
int main()
```

```
{
```

```
int num = 0;
```

```
int i;
```

```
int j;
```

```
int z = 0;
```

```
printf("Johnson trotter algorithm to find all permutations of given numbers \n");
```

```
printf("Enter the number\n");
```

```
scanf("%d",&num);
```

```
int arr[num],d[num];
```

```
z = factorial(num);
printf("The total permutations are %d",z);
printf("\nAll possible permutations are: \n");
for(i=0;i<num;i++)
{
d[i] = 0;
arr[i] = i+1;
printf(" %d ",arr[i]);
}
printf("\n");
for(j=1;j<z;j++)
{
permutations(arr,d,num);
printf("\n");
}
return 0;
}
```

OUTPUT:-

```
C:\Users\Admin\Desktop\415\jt.exe
Enter the value of n: 3
1 2 3
1 3 2
3 1 2
3 2 1
2 3 1
2 1 3

Process returned 0 (0x0)   execution time : 5.224 s
Press any key to continue.
_
```

```
C:\Users\Admin\Desktop\1bmcs22\trotter.exe
The total permutations are 24
All possible 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 : 14.616 s
Press any key to continue.
_
```

LAB PROGRAM-04

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>

void mergesort(int a[],int i,int j);

void merge(int a[],int i1,int j1,int i2,int j2);
```

```
int main()
{
    int a[30],n,i;
    printf("Enter no of elements:");
    scanf("%d",&n);
    printf("Enter array elements:");
    for(i=0;i<n;i++)
        scanf("%d",&a[i]);
    mergesort(a,0,n-1);
    printf("\nSorted array is :");
    for(i=0;i<n;i++)
        printf("%d ",a[i]);
    return 0;
}
```

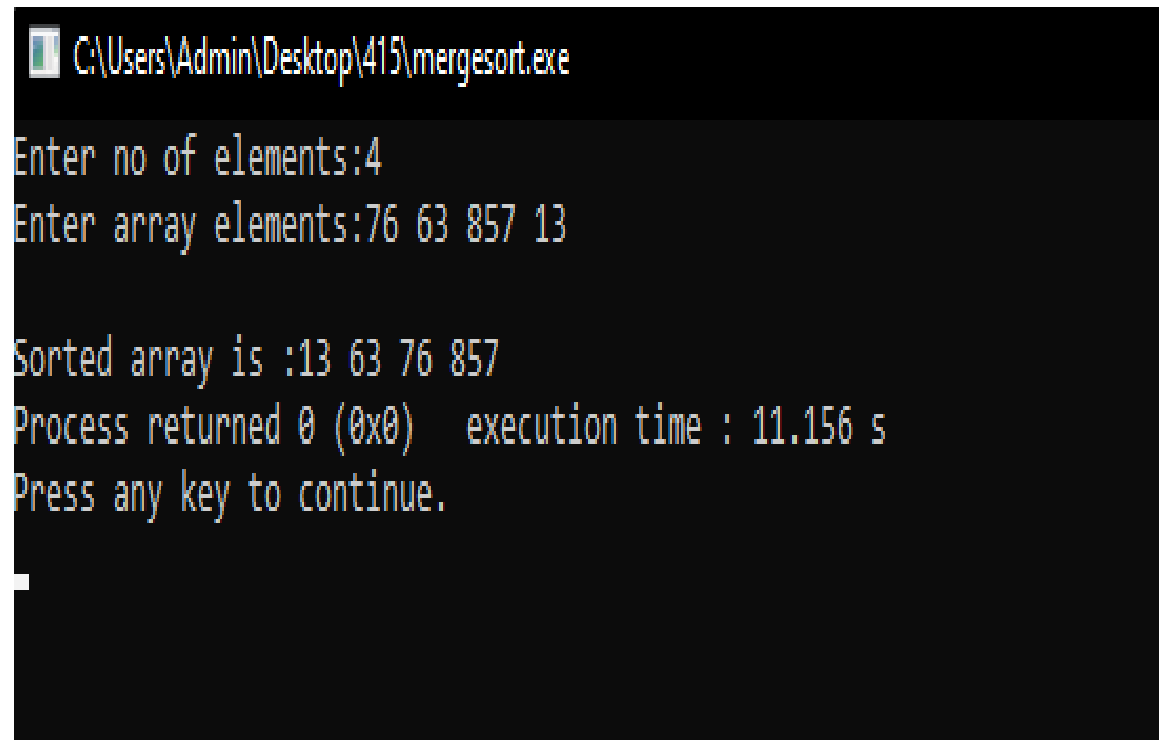
```
void mergesort(int a[],int i,int j)
{
```

```
int mid;
if(i<j)
{
mid=(i+j)/2;
mergesort(a,i,mid);
mergesort(a,mid+1,j);
merge(a,i,mid,mid+1,j);
}
}
```

```
void merge(int a[],int i1,int j1,int i2,int j2)
{
int temp[50];
int i,j,k;
i=i1;
j=i2;
k=0;
while(i<=j1 && j<=j2)
{
if(a[i]<a[j])
temp[k++]=a[i++];
else
temp[k++]=a[j++];
}
while(i<=j1)
```

```
temp[k++]=a[i++];  
while(j<=j2)  
temp[k++]=a[j++];  
  
for(i=i1,j=0;i<=j2;i++,j++)  
a[i]=temp[j];  
}
```

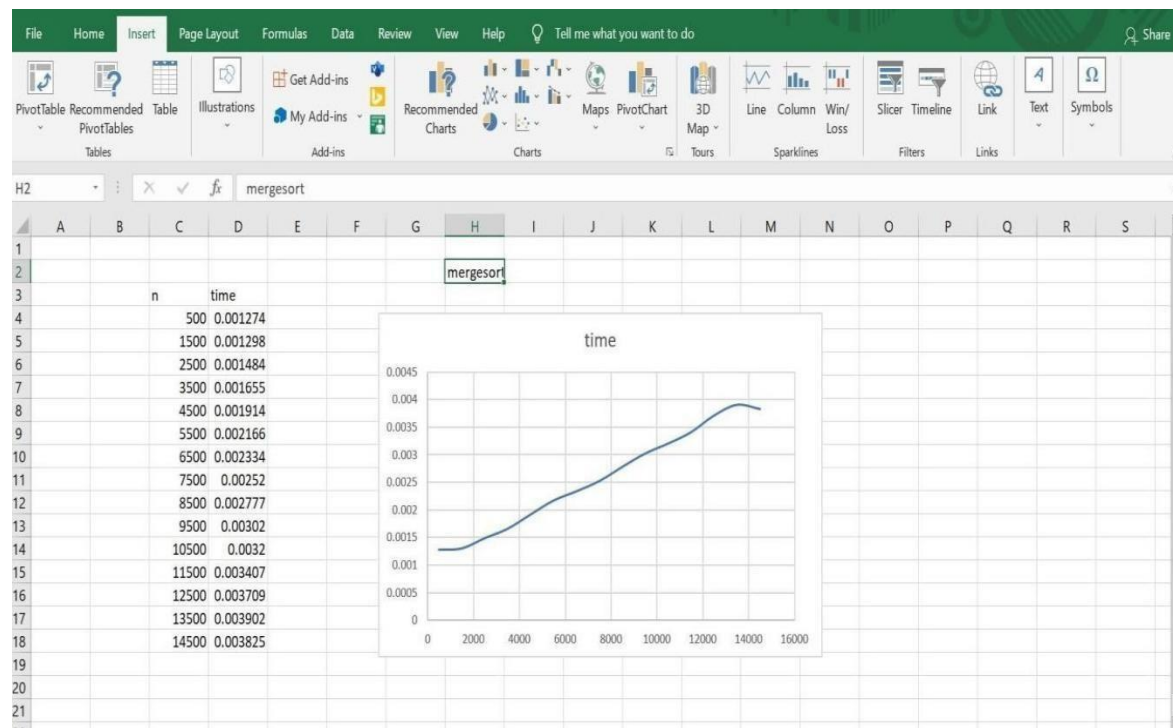
OUTPUT:-



```
C:\Users\Admin\Desktop\415\mergesort.exe  
Enter no of elements:4  
Enter array elements:76 63 857 13  
  
Sorted array is :13 63 76 857  
Process returned 0 (0x0)   execution time : 11.156 s  
Press any key to continue.  
_
```

```
C:\Users\Admin\Desktop\415\mergesort.exe
Enter no of elements:6
Enter array elements:32 54 2 43 65 23

Sorted array is :2 23 32 43 54 65
Process returned 0 (0x0)   execution time : 11.328 s
Press any key to continue.
```



LAB PROGRAM-05

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

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

```
C:\Users\Admin\Desktop\415\quick.exe
Enter the number of array elements:
7
Enter the array elements:
41
467
334
500
169
724
478
Sorted array:
41
169
334
467
478
500
724
Time taken to search an given element in an array of is 0.000000

Process returned 65 (0x41)   execution time : 4.859 s
Press any key to continue.
```

```
C:\Users\Admin\Desktop\1bmcs22\QUICK.exe
Enter the number of array elements:
5
Enter the array elements:
41
467
334
500
169
Sorted array:
41
169
334
467
500
Time taken to search an given element in an array of is 0.000000

Process returned 65 (0x41)   execution time : 6.422 s
Press any key to continue.
```


LAB PROGRAM-06

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

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

void swap(int *,int *);
void heapify(int [],int,int);
void heapSort(int[], int);
int main()
{
    int a[15000],n,i,j,ch,temp;
    clock_t start,end;
    while(1)
    {
        printf("\n 1: For manual entry of N values and array elements:");
        printf("\n 2: To display time taken for sorting number of elements N in the range
        500 to 14500:");
        printf("\n 3: To exit");
        printf("\n Enter your choice:");
        scanf("%d",&ch);
        switch(ch)
        {
            case 1: printf("\n Enter the number of elements:");
```

```

scanf("%d",&n);
printf("\n Enter array elements:");
for(i=0;i<n;i++)
{
scanf("%d",&a[i]);
}
start=clock();
heapSort(a, n);
end=clock();
printf("\n Sorted array is:");

for(i=n-1;i>=0;i--){
printf("%d\t",a[i]);
}

printf("\n Time taken to sort %d numbers is %f secs",n,((double)(end-
start)/CLOCKS_PER_SEC));
break;
case 2:
n=500;
while(n<=14500){
for(i=0;i<n;i++){
a[i]=n-i;
}
start=clock();
heapSort(a, n);

```

```

for(j=0;j<50000000;j++){
temp=38/600;
}
end=clock();
printf("\n Time taken to sort %d numbers is %f secs",n,((double)(end-
start)/CLOCKS_PER_SEC));
n=n+1000;
}
break;

case 3: exit(0);
}
}
}

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);
}
}

```

OUTPUT:-

```
C:\Users\Admin\Desktop\lbmc22\Heapsort.exe
Enter the number of elements:5

Enter array elements:23 12 34 56 78

Sorted array is:78    56    34    23    12
Time taken to sort 5 numbers is 0.000000 secs
1: For manual entry of N values and array elements:
2: To display time taken for sorting number of elements N in the range 500 to 14500:
3: To exit
Enter your choice:2

Time taken to sort 500 numbers is 0.016000 secs
Time taken to sort 1500 numbers is 0.015000 secs
Time taken to sort 2500 numbers is 0.016000 secs
Time taken to sort 3500 numbers is 0.015000 secs
Time taken to sort 4500 numbers is 0.016000 secs
Time taken to sort 5500 numbers is 0.016000 secs
Time taken to sort 6500 numbers is 0.015000 secs
Time taken to sort 7500 numbers is 0.000000 secs
Time taken to sort 8500 numbers is 0.000000 secs
Time taken to sort 9500 numbers is 0.016000 secs
Time taken to sort 10500 numbers is 0.015000 secs
Time taken to sort 11500 numbers is 0.016000 secs
Time taken to sort 12500 numbers is 0.015000 secs
Time taken to sort 13500 numbers is 0.016000 secs
Time taken to sort 14500 numbers is 0.016000 secs
1: For manual entry of N values and array elements:
2: To display time taken for sorting number of elements N in the range 500 to 14500:
3: To exit
Enter your choice:
```

C:\Users\Admin\Desktop\415\heap.exe

Enter the number of elements:6

Enter array elements:12 34 56 23 34 56

Sorted array is:56 56 34 34 23 12

Time taken to sort 6 numbers is 0.000000 secs

1: For manual entry of N values and array elements:

2: To display time taken for sorting number of elements N in the range 500 to 14500:

3: To exit

Enter your choice:2

Time taken to sort 500 numbers is 0.016000 secs

Time taken to sort 1500 numbers is 0.000000 secs

Time taken to sort 2500 numbers is 0.000000 secs

Time taken to sort 3500 numbers is 0.016000 secs

Time taken to sort 4500 numbers is 0.016000 secs

Time taken to sort 5500 numbers is 0.015000 secs

Time taken to sort 6500 numbers is 0.016000 secs

Time taken to sort 7500 numbers is 0.016000 secs

Time taken to sort 8500 numbers is 0.015000 secs

Time taken to sort 9500 numbers is 0.016000 secs

Time taken to sort 10500 numbers is 0.016000 secs

Time taken to sort 11500 numbers is 0.015000 secs

Time taken to sort 12500 numbers is 0.016000 secs

Time taken to sort 13500 numbers is 0.015000 secs

Time taken to sort 14500 numbers is 0.016000 secs

1: For manual entry of N values and array elements:

2: To display time taken for sorting number of elements N in the range 500 to 14500:

3: To exit

Enter your choice:█

LAB PROGRAM-07

Implement 0/1 Knapsack problem using dynamic programming.

```
#include<stdio.h>

void knapsack();

int max(int,int);

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

void main()

{

printf("\n enter the no. of items:\t");

scanf("%d",&n);

printf("\n enter the weight of the each item:\n ");

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

{

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

}

printf("\n enter the profit of each item:\n ");

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

{

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

}

printf("\n enter the capacity:\t ");

scanf("%d",&m);

knapsack();

}

void knapsack()
```

```

{
int x[10];
for(i=0;i<=n;i++)
{
for(j=0;j<=m;j++)
{
if(i==0 || j==0)
{

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

printf("\n the output is:\n");
for(i=0;i<=n;i++)
{
for(j=0;j<=m;j++)

```

```

{
printf("%d\t",v[i][j]);
}
printf("\n\n");
}
printf("\nthe optimal solution is %d",v[n][m]);
printf("\nthe solution vector is:\n");
for(i=n;i>=1;i--)
{
if(v[i][m]!=v[i-1][m])
{

x[i]=1;
m=m-w[i];
}
else
{
x[i]=0;
}
}

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

```

```

}
int max(int x,int y)
{
if(x>y)
{
return x;
}
else
{
return y;
}
}

```

OUTPUT:-

```

C:\Users\kavan\OneDrive\Desktop > g++ knapsack.cpp &&
enter the no. of items: 4
enter the weight of the each item: 1 2 3 4
enter the profit of each item: 2 3 4 5
enter the capacity: 3
the output is:
0 0 0 0
0 2 2 2
0 2 3 5
0 2 3 5
0 2 3 5

the optimal solution is 5
the solution vector is:
1 1 0 0
Process returned 4 (0x4) execution time : 16.089 s
Press any key to continue.

```

```
C:\Users\kavan\OneDrive\Des  × + ▾
enter the no. of items:      5

enter the weight of the each item:
2 3 4 5 6

enter the profit of each item:
7 8 9 5 4

enter the capacity:  5

the output is:
0      0      0      0      0      0
0      0      7      7      7      7
0      0      7      8      8      15
0      0      7      8      9      15
0      0      7      8      9      15
0      0      7      8      9      15

the optimal solution is 15
the solution vector is:
1      1      0      0      0
Process returned 5 (0x5)   execution time : 20.218 s
Press any key to continue.
```


LAB PROGRAM-08

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

```
#include<stdio.h>

int a[10][10],n;

void floyds();

int min(int,int);

void main()
{
    int i,j;
    printf("\n enter the no. of vertices:\t");
    scanf("%d",&n);
    printf("\n enter the cost matrix:\n");
    for(i=1;i<=n;i++)
    {
        for(j=1;j<=n;j++)
        {
            scanf("%d",&a[i][j]);
        }
    }
    floyds();
}

void floyds()
{
    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]);

}
}
}

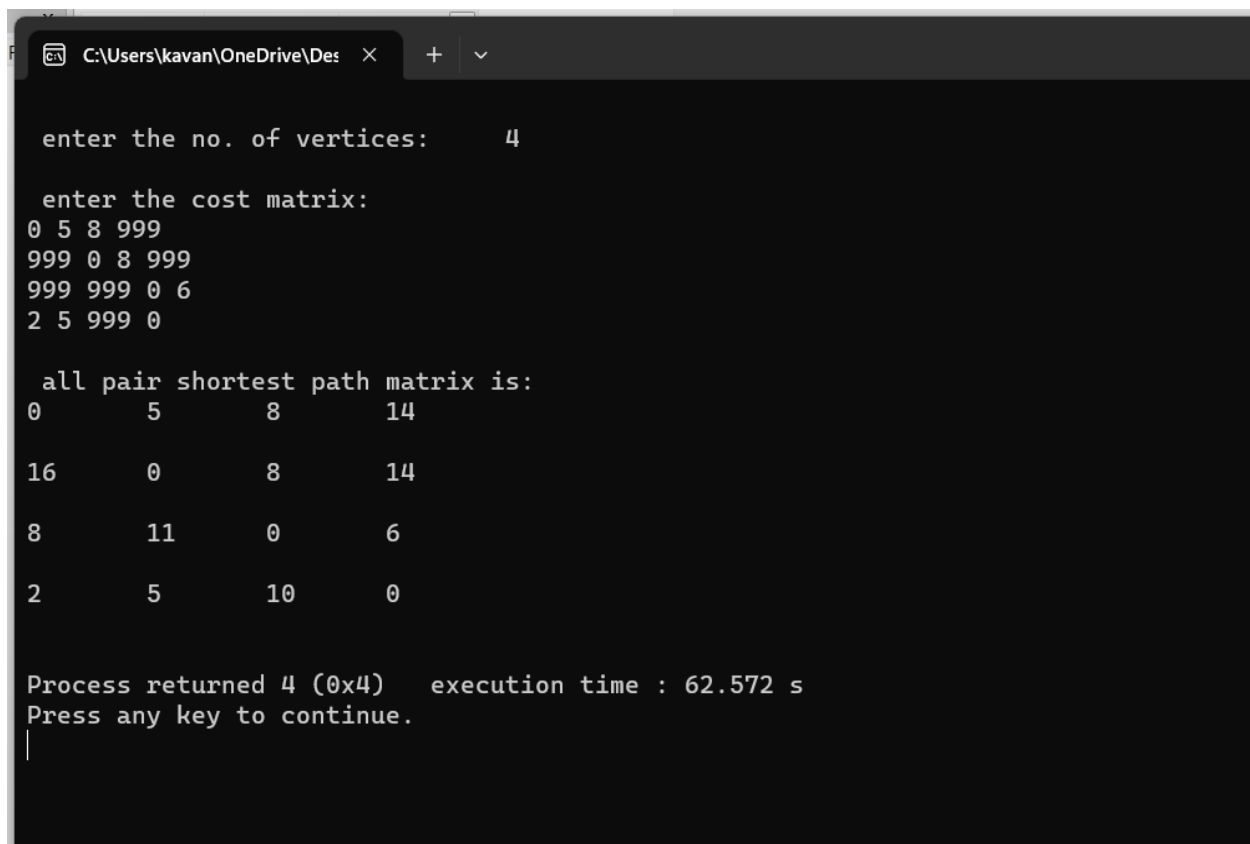
printf("\n all pair shortest path matrix is:\n");
for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
printf("%d\t",a[i][j]);
}
printf("\n\n");
}
}

int min(int x,int y)
{
if(x<y)
{

```

```
return x;
}
else
{
return y;
}
}
```

OUTPUT:-



```
C:\Users\kavan\OneDrive\Desktop >
enter the no. of vertices: 4
enter the cost matrix:
0 5 8 999
999 0 8 999
999 999 0 6
2 5 999 0
all pair shortest path matrix is:
0      5      8      14
16     0      8      14
8      11     0      6
2      5     10     0
Process returned 4 (0x4)   execution time : 62.572 s
Press any key to continue.
```

```
1 #include<stdio.h>

enter the no. of vertices: 3

enter the cost matrix:
0 4 999
999 0 7
2 3 0

all pair shortest path matrix is:
0      4      11
9      0      7
2      3      0

Process returned 3 (0x3)   execution time : 68.616 s
Press any key to continue.
|
```

LAB PROGRAM-09

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

PRIM'S:-

```
#include<stdio.h>

int main()
{
int cost[10][10],visited[10]={0},i,j,n,no_e=1,min,a,b,min_cost=0;
printf("Enter number of nodes ");
scanf("%d",&n);
printf("Enter cost in form of adjacency matrix\n");
//input graph
for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
scanf("%d",&cost[i][j]);
// cost is 0 then initialize it by maximum value
if(cost[i][j]==0)
cost[i][j]=1000;
}
}

// logic for finding minimum cost spanning tree
visited[1]=1; // visited first node
```

```

while(no_e<n)
{
min=1000;
// in each cycle find minimum cost
for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
if(cost[i][j]<min)
{
if(visited[i]!=0)
{
min=cost[i][j];
a=i;
b=j;
}
}
}
}
//if node is not visited
if(visited[b]==0)
{
printf("\n%d to %d cost=%d",a,b,min);
min_cost=min_cost+min;
no_e++;
}
}

```

```

}
visited[b]=1;
// initialize with maximum value you can also use any other value
cost[a][b]=cost[b][a]=1000;
}
printf("\nminimum weight is %d",min_cost);
return 0;
}

```

OUTPUT:-

```

C:\Users\kavan\OneDrive\Desktop
Enter number of nodes 5
Enter cost in form of adjacency matrix
0 4 999 7 999
5 0 2 4 999
999 1 0 6 4
6 3 4 0 1
999 999 6 2 0

1 to 2 cost=4
2 to 3 cost=2
2 to 4 cost=4
4 to 5 cost=1
minimum weight is 11
Process returned 0 (0x0) execution time : 100.269 s
Press any key to continue.

```

```
C:\Users\kavan\OneDrive\Des  × + v
Enter number of nodes 3
Enter cost in form of adjacency matrix
0 5 999
5 0 1
999 1 0
1 to 2 cost=5
2 to 3 cost=1
minimum weight is 6
Process returned 0 (0x0) execution time : 28.723 s
Press any key to continue.
```

KRUSKAL'S:-

```
#include<stdio.h>
#include<conio.h>
void kruskals();
int c[10][10],n;
void main()
{
int i,j;
printf("\nEnter the no. of vertices:\t");
scanf("%d",&n);
printf("\nEnter the cost matrix:\n");
for(i=1;i<=n;i++)
{
for(j=1;j<=n;j++)
{
```



```
scanf("%d",&c[i][j]);  
}  
}  
kruskals();  
}
```

```
void kruskals()  
{  
int i,j,u,v,a,b,min;  
int ne=0,mincost=0;  
int parent[10];  
for(i=1;i<=n;i++)  
{  
parent[i]=0;  
}  
while(ne!=n-1)  
{  
min=9999;  
for(i=1;i<=n;i++)  
{  
for(j=1;j<=n;j++)  
{  
if(c[i][j]<min)  
{  
min=c[i][j];
```

```

u=a=i;
v=b=j;
}
}
}
while(parent[u]!=0)
{
u=parent[u];
}
while(parent[v]!=0)
{
v=parent[v];
}
if(u!=v)
{
printf("\n%d----->%d=%d\n",a,b,min);
parent[v]=u;
ne=ne+1;
mincost=mincost+min;
}
c[a][b]=c[b][a]=9999;
}
printf("\nmincost=%d",mincost);
}

```

OUTPUT:-

```
C:\Users\kavan\OneDrive\Des  X + v

enter the no. of vertices:      4

enter the cost matrix:
0 5 999 6
5 0 1 4
999 1 0 5
6 3 4 0

2----->3=1

4----->2=3

1----->2=5

mincost=9
Process returned 10 (0xA)   execution time : 45.846 s
Press any key to continue.
```

```
C:\Users\kavan\OneDrive\Des  X + v

enter the no. of vertices:      3

enter the cost matrix:
0 2 3
2 0 999
3 5 0

1----->2=2

1----->3=3

mincost=5
Process returned 10 (0xA)   execution time : 30.457 s
Press any key to continue.
```

LAB PROGRAM-10

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

```
#include<stdio.h>
#include<conio.h>
void dijkstras();
int c[10][10],n,src;
void main()
{
    int i,j;
    printf("\nenter the no of vertices:\t");
    scanf("%d",&n);
    printf("\nenter the cost matrix:\n");
    for(i=1;i<=n;i++)
    {
        for(j=1;j<=n;j++)
        {
            scanf("%d",&c[i][j]);
        }
    }
    printf("\nenter the source node:\t");
    scanf("%d",&src);
    dijkstras();
}
```

```

void dijkstras()
{
int vis[10],dist[10],u,j,count,min;
for(j=1;j<=n;j++)
{
dist[j]=c[src][j];
}
for(j=1;j<=n;j++)
{
vis[j]=0;
}
dist[src]=0;
vis[src]=1;
count=1;
while(count!=n)
{
min=9999;
for(j=1;j<=n;j++)
{
if(dist[j]<min&&vis[j]!=1)
{
min=dist[j];
u=j;
}
}
}
}

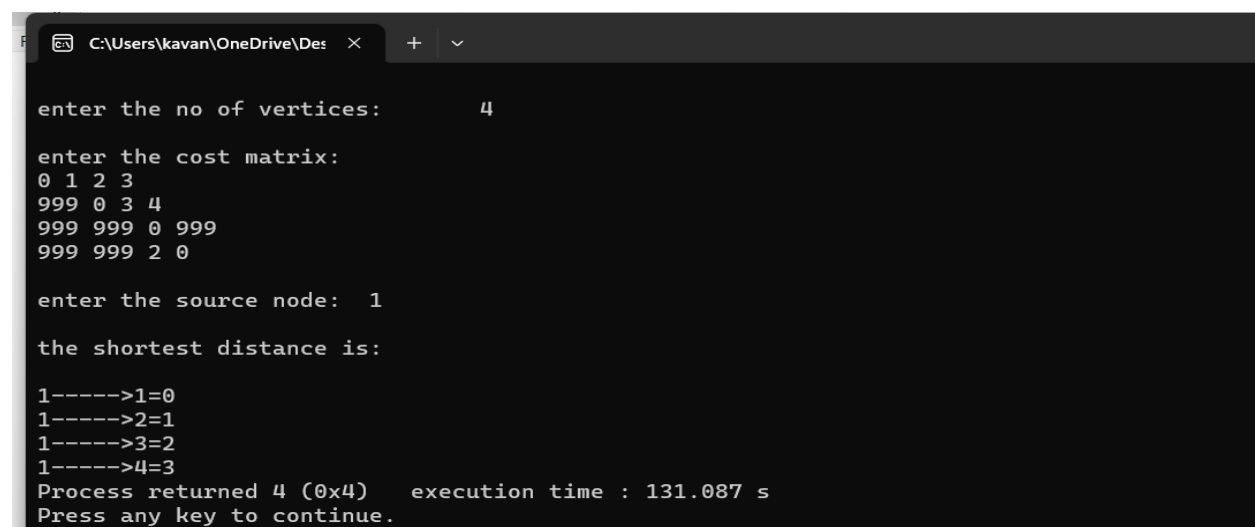
```

```

vis[u]=1;
count++;
for(j=1;j<=n;j++)
{
if(min+c[u][j]<dist[j]&&vis[j]!=1)
{
dist[j]=min+c[u][j];
}
}
}
printf("\nthe shortest distance is:\n");
for(j=1;j<=n;j++)
{
printf("\n%d----->%d=%d",src,j,dist[j]);
}
}

```

OUTPUT:-



```

C:\Users\kavan\OneDrive\Des x + v
enter the no of vertices: 4
enter the cost matrix:
0 1 2 3
999 0 3 4
999 999 0 999
999 999 2 0
enter the source node: 1
the shortest distance is:
1----->1=0
1----->2=1
1----->3=2
1----->4=3
Process returned 4 (0x4) execution time : 131.087 s
Press any key to continue.

```

```
1 #include<stdio.h>

C:\Users\kavan\OneDrive\Des X + v

enter the no of vertices:      5

enter the cost matrix:
0 2 999 999 999
999 0 3 4 2
999 999 0 999 1
999 999 999 0 999
999 999 999 6 0

enter the source node: 1

the shortest distance is:

1----->1=0
1----->2=2
1----->3=5
1----->4=6
1----->5=4
Process returned 5 (0x5)   execution time : 99.240 s
Press any key to continue.
|
```

LAB PROGRAM-11

Implement “N-Queens Problem” using Backtracking.

```
#include<stdio.h>

#include<math.h>

int a[30],count=0;

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

void print_sol(int n) {
    int i,j;
    count++;
    printf("\n\nSolution # %d:\n",count);
    for (i=1;i<=n;i++) {
        for (j=1;j<=n;j++) {
            if(a[i]==j)
                printf("Q\t"); else
                printf("*\t");
        }
        printf("\n");
    }
```



```

}
}
void queen(int n) {
int k=1;
a[k]=0;
while(k!=0) {
a[k]=a[k]+1;
while((a[k]<=n)&&!place(k))
a[k]++;
if(a[k]<=n) {

if(k==n)
print_sol(n); else {
k++;
a[k]=0;
}
} else
k--;
}
}

void main() {
int i,n;
printf("Enter the number of Queens\n");
scanf("%d",&n);
queen(n);

```

```
printf("\nTotal solutions=%d",count);
}
```

OUTPUT:-

```
C:\Users\kavan\OneDrive\Des >
Enter the number of Queens
4

Solution #1:
*      Q      *      *
*      *      *      Q
Q      *      *      *
*      *      Q      *

Solution #2:
*      *      Q      *
Q      *      *      *
*      *      *      Q
*      Q      *      *

Total solutions=2
Process returned 18 (0x12)    execution time : 2.696 s
Press any key to continue.
```

```
C:\Users\kavan\OneDrive\Des >
Enter the number of Queens
5

Solution #1:
Q      *      *      *      *
*      *      Q      *      *
*      *      *      *      Q
*      Q      *      *      *
*      *      *      Q      *

Solution #2:
Q      *      *      *      *
*      *      *      Q      *
*      Q      *      *      *
*      *      *      *      Q
*      *      Q      *      *

Solution #3:
*      Q      *      *      *
*      *      *      Q      *
Q      *      *      *      *
*      *      Q      *      *
*      *      *      *      Q

Solution #4:
*      Q      *      *      *
*      *      *      *      Q
*      *      Q      *      *
Q      *      *      *      *
*      *      *      Q      *
```

Solution #4:

```
*      Q      *      *      *
*      *      *      *      Q
*      *      Q      *      *
Q      *      *      *      *
*      *      *      Q      *
```

Solution #5:

```
*      *      Q      *      *
Q      *      *      *      *
*      *      *      Q      *
*      Q      *      *      *
*      *      *      *      Q
```

Solution #6:

```
*      *      Q      *      *
*      *      *      *      Q
*      Q      *      *      *
*      *      *      Q      *
Q      *      *      *      *
```

Solution #7:

```
*      *      *      Q      *
Q      *      *      *      *
*      *      Q      *      *
*      *      *      *      Q
*      Q      *      *      *
```

Solution #8:

```
*      *      *      Q      *
*      Q      *      *      *
*      *      *      *      Q
*      *      Q      *      *
Q      *      *      *      *
```

Solution #8:

```
*      *      *      Q      *
*      Q      *      *      *
*      *      *      *      Q
*      *      Q      *      *
Q      *      *      *      *
```

Solution #9:

```
*      *      *      *      Q
*      Q      *      *      *
*      *      *      Q      *
Q      *      *      *      *
*      *      Q      *      *
```

Solution #10:

```
*      *      *      *      Q
*      *      Q      *      *
Q      *      *      *      *
*      *      *      Q      *
*      Q      *      *      *
```

Total solutions=10

Process returned 19 (0x13)

Press any key to continue.

execution time : 10.146 s