Lesson Planning / Schedule of Experiments

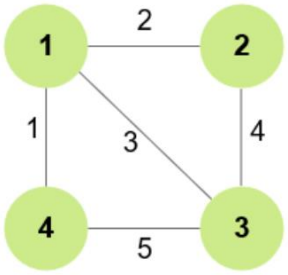
Sl. No	List of Programs
1	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
2	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
3	a) Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b) Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
4	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
5	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.
6	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
7	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
8	Design and implement C/C++ Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.
9	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
10	Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
11	Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
12	Design and implement C/C++ Program for N Queen's problem using Backtracking.

1. Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.

```
#include<stdio.h>
int cost[10][10],n;

void kruskal()
{
   int par[n];
   int a=0,b=0,u=0,v=0,min, mincost = 0, ne = 0;
   for(int i=0;i<n;i++)
      par[i]=-1;

   printf("the minimum spanning tree edges are...");
   while(ne < n-1)
   {
      //Find the least cost edge
            min = 999;
      for(int i=0;i<n;i++)
         for(int j=0;j<n;j++)
            if(cost[i][j] < min)
            {
               min=cost[i][j];
               a=u=i;
               b=v=j;
            }

      //Check if edge select cause cyclicity?
            while(par[u]!=-1)
         u=par[u];

      while(par[v]!=-1)
         v=par[v];

      if(u!=v)
      {
         printf("From vertex %d to vertex %d and the cost = %d\n",a,b,min);
         mincost+=min;
         par[v]=u;
         ne++;
      }
      //edge included in MST should not be considered for next iteration
            cost[a][b]=cost[b][a]=999;
   }
   printf("Cost of MST = %d", mincost);
}

void main()
{
   printf("Enter the no. of vertices:");
   scanf("%d",&n);
         printf("Enter the cost matrix\n");
```

```
    for(int i=0;i<n;i++)
        for(int j=0;j<n;j++)
            scanf("%d",&cost[i][j]);
    kruskal();
}
```

Sample Input and Output:

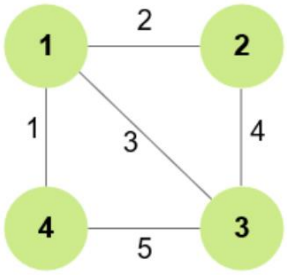


Enter the no. of vertices:4
Enter the cost matrix
999 2 3 1
2 999 4 999
3 4 999 5
1 999 5 999
the minimum spanning tree edges are...
From vertex 0 to vertex 3 and the cost = 1
From vertex 0 to vertex 1 and the cost = 2
From vertex 0 to vertex 2 and the cost = 3
Cost of MST = 6

2. Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.

```
#include<stdio.h>
int cost[10][10],n;

void prim()
{
   int vt[10]={0};
   int a=0,b=0,min, mincost = 0, ne = 0;
   //start from the first vertex
         vt[0] = 1;
   while(ne < n-1)
   {
      //Find the nearest neighbour
            min = 999;
      for (int i = 0; i<n; i++)
      {
         if(vt[i]==1)
            for(int j = 0;j <n; j++)
               if(cost[i][j] < min && vt[j]==0)
               {
                  min = cost[i][j];
                  a = i;
                  b = j;
               }
      }
      //Include nearest neighbour 'b' into MST
      printf("Edge from vertex %d to vertex %d and the cost %d\n",a,b,min);
      vt[b] = 1;
      ne++;
      mincost += min;
      cost[a][b] = cost[b][a] = 999;
   }
   printf("minimum spanning tree cost is %d",mincost);
}

void main()
{
   printf("Enter the no. of vertices: ");
         scanf("%d",&n);
         printf("Enter the cost matrix\n");
   for(int i=0;i<n;i++)
      for(int j=0;j<n;j++)
         scanf("%d",&cost[i][j]);
   prim();
}
```

Sample Input and Output:

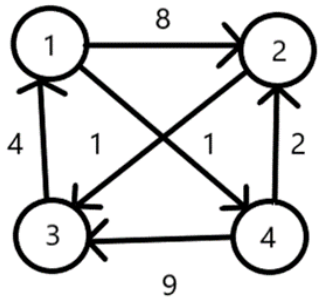


Enter the no. of vertices: 4
Enter the cost matrix
999 2 3 1
2 999 4 999
3 4 999 5
1 999 5 999
Edge from vertex 0 to vertex 3 and the cost 1
Edge from vertex 0 to vertex 1 and the cost 2
Edge from vertex 0 to vertex 2 and the cost 3
minimum spanning tree cost is 6

3a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm.

```
#include<stdio.h>

int min(int a, int b)
{
	return(a < b ? a : b);
}

void floyd(int D[][10],int n)
{
   for(int k=1;k<=n;k++)
      for(int i=1;i<=n;i++)
         for(int j=1;j<=n;j++)
            D[i][j]=min(D[i][j],D[i][k]+D[k][j]);
}

int main()
{
   int n, cost[10][10];
   printf("Enter no. of Vertices: ");
   scanf("%d",&n);
   printf("Enter the cost matrix\n");
   for(int i=1;i<=n;i++)
            for(int j=1;j<=n;j++)
         scanf("%d",&cost[i][j]);
   floyd(cost,n);

   printf("All pair shortest path\n");
   for(int i=1;i<=n;i++)
   {
                  for(int j=1;j<=n;j++)
         printf("%d  ",cost[i][j]);
      printf("\n");
   }
}
```

Sample Input and Output:



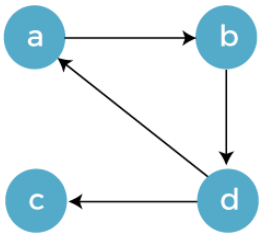

```
Enter no. of Vertices: 4
Enter the cost matrix
999 8 4 999
999 999 1 999
```

4 999 999 999
999 2 9 999
All pair shortest path
8 8 4 999
5 13 1 999
4 12 8 999
7 2 3 999

3b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.

```
#include<stdio.h>

void warshal(int A[][10],int n)
{
   for(int k=1;k<=n;k++)
      for(int i=1;i<=n;i++)
         for(int j=1;j<=n;j++)
            A[i][j]=A[i][j] || (A[i][k] && A[k][j]);
}

void main()
{
   int n, adj[10][10];
   printf("Enter no. of Vertices: ");
   scanf("%d",&n);
   printf("Enter the adjacency matrix\n");
   for(int i=1;i<=n;i++)
      for(int j=1;j<=n;j++)
         scanf("%d",&adj[i][j]);
   warshal(adj,n);

   printf("Transitive closure of the given graph is\n");
   for(int i=1;i<=n;i++)
   {
         for(int j=1;j<=n;j++)
         printf("%d  ",adj[i][j]);
      printf("\n");
   }
}
```

Sample Input and Output:



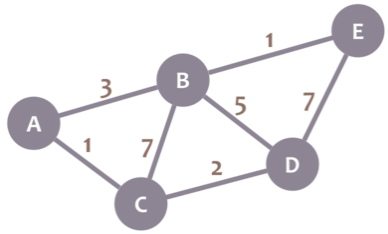

```
Enter no. of Vertices: 4
Enter the adjacency matrix
0 1 0 0
0 0 0 1
0 0 0 0
1 0 1 0
Transitive closure of the given graph is
1  1  1  1
1  1  1  1
0  0  0  0
1  1  1  1
```

4. Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.

```
#include<stdio.h>

int cost[10][10],n,dist[10];


int minm(int m, int n)
{
   return(( m < n) ? m: n);
}

void dijkstra(int source)
{
   int s[10]={0};
   int min, w=0;

   for(int i=0;i<n;i++)
         dist[i]=cost[source][i];

   //Initialize dist from source to source as 0
   dist[source] = 0;

   //mark source vertex - estimated for its shortest path
   s[source] = 1;
   for(int i=0; i < n-1; i++)
   {
      //Find the nearest neighbour vertex
      min = 999;
      for(int j = 0; j < n; j++)
      {
                        if ((s[j] == 0 ) && (min > dist[j]))
         {
            min = dist[j];
            w = j;
         }
      }
      s[w]=1;
      //Update the shortest path of neighbour of w
      for(int v=0;v<n;v++)
      {
                        if(s[v]==0 && cost[w][v]!=999)
         {
                  dist[v]= minm(dist[v],dist[w]+cost[w][v]);
         }
      }
   }
}

int main()
{
```

```
    int source;

    printf("Enter the no.of vertices:");
    scanf("%d",&n);
    printf("Enter the cost matrix\n");
    for(int i=0;i<n;i++)
        for(int j=0;j<n;j++)
            scanf("%d",&cost[i][j]);

    printf("Enter the source vertex:");
    scanf("%d",&source);
    dijkstra(source);

    printf("the shortest distance is...");
    for(int i=0; i<n; i++)
        printf("Cost from %d to %d is %d\n",source,i,dist[i]);
}
```

Sample Input and Output:



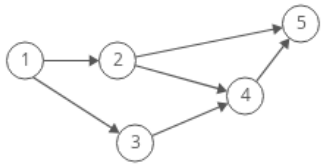

```
Enter the no.of vertices:5
Enter the cost matrix
0 3 1 999 999
3 0 7 5 1
1 7 0 2 999
999 5 2 0 7
999 1 999 7 0
Enter the source vertex:0
the shortest distance is...Cost from 0 to 0 is 0
Cost from 0 to 1 is 3
Cost from 0 to 2 is 1
Cost from 0 to 3 is 3
Cost from 0 to 4 is 4
```

5. Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.

//Solved using Source removal Method

```
#include<stdio.h>

int cost[10][10],n,colsum[10];

void cal_colsum()
{
        for(int j=0;j<n;j++)
        {
                colsum[j]=0;
                for(int i=0;i<n;i++)
                        colsum[j]+=cost[i][j];
        }
}

void source_removal()
{
        int i,j,k,select[10]={0};
        printf("Topological ordering is:");
        for(i=0;i<n;i++)
        {
                //Calculate the outdegree for each vertices
                cal_colsum();
                for(j=0;j<n;j++)
                {
                        if(select[j]==0 && colsum[j]==0)//source vertex
                                break;
                }
                printf("%d ",j);
                select[j]=1;
                //Remove source vertex j from cost matrix
                for(k=0;k<n;k++)
                        cost[j][k]=0;
        }
}

void main()
{
   printf("Enter no. of Vertices: ");
   scanf("%d",&n);
   printf("Enter the cost matrix\n");
   for(int i=0;i<n;i++)
      for(int j=0;j<n;j++)
         scanf("%d",&cost[i][j]);
   source_removal();
}
```

Sample Input and Output:



Enter no. of Vertices: 5
Enter the cost matrix
0 1 1 0 0
0 0 0 1 1
0 0 0 1 0
0 0 0 0 1
0 0 0 0 0
Topological ordering is:0 1 2 3 4

6. Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.

```
#include<stdio.h>
int n,m,p[10],w[10];

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

void knapsack_DP()
{
   int V[10][10],i,j;
   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])//weight of the item is larger than capacity
            V[i][j]=V[i-1][j];
         else
            V[i][j]=max(V[i-1][j],p[i]+V[i-1][j-w[i]]);//maximization

   for(i=0;i<=n;i++)
   {
      for(j=0;j<=m;j++)
         printf("%d  ",V[i][j]);
      printf("\n");
   }
   /* tracking back the optimal solution vector */
   printf("Items included are:");
   while(n > 0)
   {
      if(V[n][m] != V[n-1][m])
      {
         printf("%d  ",n);
         m = m - w[n];
      }
      n--;
   }
}

int main()
{
   int i;
   printf("Enter the no. of items: ");
   scanf("%d",&n);
   printf("Enter the weights of n items: ");
   for(i=1;i<=n;i++)
      scanf("%d",&w[i]);
   printf("Enter the prices of n items: ");
   for(i=1;i<=n;i++)
```

```
        scanf("%d",&p[i]);
    printf("Enter the capacity of Knapsack: ");
    scanf("%d",&m);
    knapsack_DP();
}
```

Sample Input and Output:

```
Enter the no. of items: 4
Enter the weights of n items: 7 3 4 5
Enter the prices of n items: 42 12 40 25
Enter the capacity of Knapsack: 10
0  0  0  0   0   0   0   0   0   0   0
0  0  0  0   0   0   0   42  42  42  0
0  0  0  12  12  12  12  42  42  42  0
0  0  0  12  40  40  40  52  52  52  0
0  0  0  12  40  40  40  52  52  65  65
Items included are: 4  3
```

7. Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.

```
#include<stdio.h>

int n,m,p[10],w[10];
void greedy_knapsack()
{
   float max, profit=0;
   int k=0,i,j;
   printf("item included is :");
   for(i=0;i<n;i++)
   {
      max=0;
      //choose the item which has highest price to weight ratio
      for(j=0;j<n;j++)
      {
         if(((float)p[j])/w[j] > max)
         {
            k=j;
            max=((float)p[j])/w[j];
         }
      }
      //kth element has highest price to weight ratio
      if(w[k] <= m )
      {
         printf("%d",k);
         m = m - w[k];
         profit=profit+p[k];
         p[k]=0;
      }
      else
         break;//unable fit item k into knapsack
   }
   printf("Discrete Knapsack profit = %f\n",profit);
   printf("Continuous Knapsack also includes item %d with portion: %f\n", k, (float)m)/w[k]);
   profit = profit + ((float)m)/w[k] * p[k];
   printf("Continuous Knapsack profit = %f\n",profit);
}

int main()
{
   int i;
   printf("Enter the no. of items: ");
   scanf("%d",&n);
   printf("Enter the weights of n items: ");
   for(i=0;i<n;i++)
      scanf("%d",&w[i]);
   printf("Enter the prices of n items: ");
   for(i=0;i<n;i++)
      scanf("%d",&p[i]);
   printf("Enter the capacity of Knapsack: ");
```

```
   scanf("%d",&m);
   greedy_knapsack();
}
```

Sample Input and Output:

```
Enter the no. of items: 4
Enter the weights of n items: 2 1 3 2
Enter the prices of n items: 12 10 20 15
Enter the capacity of Knapsack: 5
item included is :1 3
Discrete Knapsack profit = 25.000000
Continuous Knapsack also includes item 2 with portion: 0.666667
Continuous Knapsack profit = 38.333332
```

8. Design and implement C/C++ Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.

```
#include<stdio.h>

int x[10], w[10], count, d;
void sum_of_subsets(int s, int k, int rem)
{
   x[k] = 1;
   if( s + w[k] == d)
   {
      //if subset found
      printf("subset = %d\n", ++count);
      for(int i=0 ; i <= k ; i++)
         if ( x[i] == 1)
            printf("%d  ",w[i]);
      printf("\n");
   }
   else if ( s + w[k] + w[k+1] <= d )//left tree evaluation
      sum_of_subsets(s+w[k], k+1, rem-w[k]);

   if( ( s+rem-w[k] >= d) && ( s + w[k+1]) <= d)//right tree evaluation
   {
      x[k] = 0;
      sum_of_subsets(s,k+1,rem-w[k]);
   }
}

int main()
{
   int sum = 0,n;
   printf("enter no of elements:");
   scanf("%d",&n);
   printf("enter the elements in increasing order:");
   for( int i = 0; i < n ; i++)
   {
      scanf("%d",&w[i]);
         sum=sum+w[i];
   }
   printf("eneter the sum:");
   scanf("%d",&d);

   if ( ( sum < d ) || ( w[0] > d ) )
      printf("No subset possible\n");
   else
      sum_of_subsets(0,0,sum);
}
```

Sample Input and Output:

```
enter no of elements:5
enter the elements in increasing order:1 2 3 4 5
eneter the sum:10
subset = 1
```

1 2 3 4
subset = 2
1 4 5
subset = 3
2 3 5

9. Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

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

int a[10000],n,count;

void selection_sort()
{
	for(int i=0;i<n-1;i++)
	{
		int min = i;
		for(int j=i+1;j<n;j++)
		{
			count++;
			if(a[j]<a[min])
				min=j;
		}
		int temp=a[i];
		a[i]=a[min];
		a[min]=temp;
	}
}

int main()
{
	printf("Enter the number of elements in an array:");
	scanf("%d",&n);
	printf("All the elements:");
	srand(time(0));
	for(int i=0;i<n;i++)
	{
		a[i]=rand();
		printf("%d ",a[i]);
	}
	selection_sort();
	printf("\nAfter sorting\n");
	for(int i=0;i<n;i++)
		printf("%d  ", a[i]);
	printf("\nNumber of basic operations = %d\n",count);
}
```

Sample Input and Output:

```
Enter the number of elements in an array:5
All the elements:
24152 32742 28304 4804 22274
After sorting
4804  22274  24152  28304  32742
```

Number of basic operations = 10

Enter the number of elements in an array:10
All the elements:
24243 6017 4212 23217 16170 24802 1085 24280 9847 6392
After sorting
1085 4212 6017 6392 9847 16170 23217 24243 24280 24802
Number of basic operations = 45

10. Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

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

int count=0;
int partition(int a[], int low,int high)
{
   int pivot=a[low],temp,i=low+1,j=high;
   while(1)
   {
      //Traverse i from left to right, segregating element of left group
      while(i<=high && a[i]<=pivot)//a[i]<=pivot used for avoiding multiple duplicates
      {
         i++; count++;
      }
      //Traverse j from right to left, segregating element of right group
      while(j>0 && a[j]>pivot)
      {
         j--; count++;
      }
      count+=2;
      //If grouping is incomplete
      if(i<j)
      {
         temp = a[i];
         a[i] = a[j];
         a[j] =temp;
      }
      else if(i>j)//If grouping is completed
      {
         temp = a[low];
         a[low] = a[j];
         a[j] = temp;
         return j;
      }
      else //Duplicate of Pivot found
         return j;
   }
}

void quicksort(int a[],int low, int high)
{
   int s;
   if(low<high)
   {
      //partition to place pivot element in between left and right group
      s = partition(a,low,high);
```

```
        quicksort(a,low,s-1);
        quicksort(a,s+1,high);
    }
}
int main()
{
        int a[10000],n;
        printf("Enter the number of elements in an array:");
        scanf("%d",&n);
        printf("All the elements:");
        srand(time(0));
        for(int i=0;i<n;i++)
        {
                a[i]=rand();
                printf("%d ",a[i]);
        }
        quicksort(a,0,n-1);
        printf("\nAfter sorting\n");
        for(int i=0;i<n;i++)
                printf("%d  ", a[i]);
        printf("\nNumber of basic operations = %d\n",count);
}
```

Sample Input and Output:

```
Enter the number of elements in an array:5
All the elements:
24442 6310 12583 16519 22767
After sorting
6310  12583  16519  22767  24442
Number of basic operations = 18

Enter the number of elements in an array:10
All the elements:
24530 1605 3396 10868 6349 9906 12836 28823 21075 22418
After sorting
1605  3396  6349  9906  10868  12836  21075  22418  24530  28823
Number of basic operations = 44
```

11. Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

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

int count=0;
void merge(int a[], int low,int mid,int high)
{
	int i,j,k,c[10000];

	i=low, j=mid+1, k=0;
	while((i<=mid) && (j<=high))
	{
		count++;
		//choose the least element and store in Temporary array 'C'
		if(a[i]<a[j])
			c[k++]=a[i++];
		else
			c[k++]=a[j++];
	}
	//Copy the remaining array elements from any one of sub-array
	while(i<=mid)
		c[k++]=a[i++];
	while(j<=high)
		c[k++]=a[j++];
	for(i=low,j=0;j<k;i++, j++)
		a[i]=c[j];
}

void merge_sort(int a[], int low, int high)
{
	int mid;
	if(low < high)
	{
		//Divide the given array into 2 parts
		mid=(low+high)/2;
		merge_sort(a,low,mid);
		merge_sort(a,mid+1,high);
		merge(a,low,mid,high);
	}
}

int main()
{
	int a[10000],n,i;
	printf("Enter the number of elements in an array:");
	scanf("%d",&n);
	printf("All the elements:");
```

```
        srand(time(0));
        for(i=0;i<n;i++)
        {
                a[i]=rand();
                printf("%d ",a[i]);
        }
        merge_sort(a,0,n-1);
        printf("\nAfter sorting\n");
        for(i=0;i<n;i++)
                printf("%d  ", a[i]);
        printf("\nNumber of basic operations = %d\n",count);
}
```

Sample Input and Output:

```
Enter the number of elements in an array:5
All the elements:
24759 329 8704 24132 7473
After sorting
329  7473  8704  24132  24759
Number of basic operations = 8

Enter the number of elements in an array:10
All the elements:
24854 17121 2477 1072 11684 5437 26057 1167 17322 3583
After sorting
1072  1167  2477  3583  5437  11684  17121  17322  24854  26057
Number of basic operations = 22
```

12. Design and implement C/C++ Program for N Queen's problem using Backtracking.

```
#include<stdio.h>
#include<math.h>      //for abs() function

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

int nqueens(int n)
{
        int x[10], k, count=0;

        k=1;// select the first queen
        x[k]=0; //no positions allocated
        while(k != 0)  // until all queens are present
        {
                x[k]++;      // place the kth queen in next column
                while((x[k] <= n)  && (!place(x,k)))
                        x[k]++;     // check for the next column to place queen

                if(x[k] <= n)
                {
                        if(k == n)   // all queens are placed
                        {
                                printf("\nSolution %d\n",++count);
                                for(int i=1;i <= n;i++)
                                {
                                   for(int j=1;j <= n;j++)
                                        printf("%c ",j==x[i]?'Q':'X');
                                        printf("\n");
                                }
                        }
                        else
                        {
                                ++k;                //select the next queen
                        x[k]=0;    // start from the next column
                        }
                }
                else
                        k--;             // backtrack
        }
        return count;
}

void main()
```

```
{
        int n;
        printf("Enter the size of chessboard: ");
        scanf("%d",&n);
        printf("\nThe number of possibilities are %d",nqueens(n));
}
```

Sample Input and Output:

1. Enter the size of chessboard: 4

Solution 1
X Q X X
X X X Q
Q X X X
X X Q X

Solution 2
X X Q X
Q X X X
X X X Q
X Q X X

The number of possibilities are 2

2. Enter the size of chessboard: 3

The number of possibilities are 0

3. Enter the size of chessboard: 1

Solution 1
Q

The number of possibilities are 1