CSA0672-DESIGN AND ANALYSIS OF ALGORTHM

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1) MERGE SORT

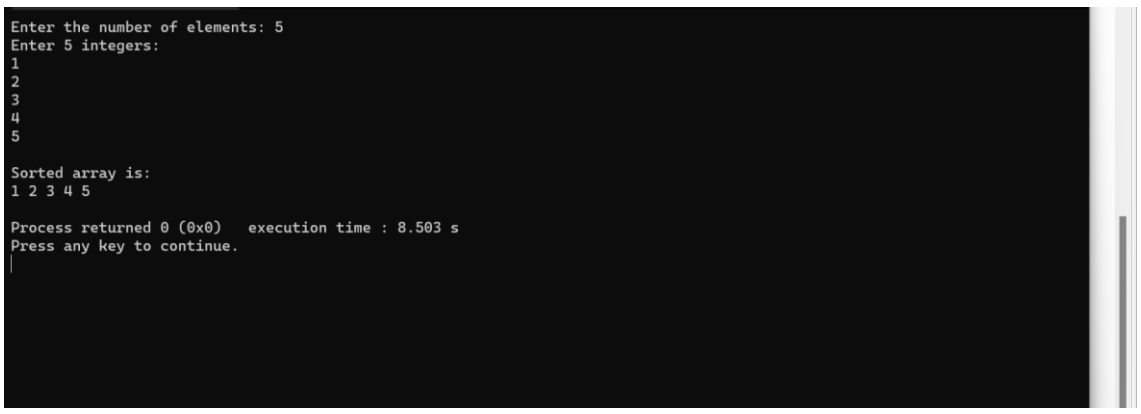
PROGRAM:

```
#include <stdio.h>
#include <stdlib.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);
    }
}
```

```
int main() {
    int n, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter %d integers:\n", n);
    for (i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }

    mergeSort(arr, 0, n - 1);

    printf("\nSorted array is: \n");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
    return 0;
}
```

OUTPUT:



2) MINIMUM AND MAXIMUM IN ARRAY

PROGRAM:

```
#include<stdio.h>
#include<stdio.h>
int max, min;
int a[100];
void maxmin(int i, int j)
{
 int max1, min1, mid;
 if(i==j)
 {
  max = min = a[i];
 }
 else
 {
  if(i == j-1)
  {
   if(a[i] <a[j])
   {
    max = a[j];
    min = a[i];
   }
   else
   {
    max = a[i];
    min = a[j];
   }
  }
```

```
 else
 {
  mid = (i+j)/2;
  maxmin(i, mid);
  max1 = max; min1 = min;
  maxmin(mid+1, j);
  if(max <max1)
   max = max1;
  if(min > min1)
   min = min1;
 }
}
}
int main ()
{
 int i, num;
 printf ("\nEnter the total number of numbers : ");
 scanf ("%d",&num);
 printf ("Enter the numbers : \n");
 for (i=1;i<=num;i++)


 max = a[0];
 min = a[0];
 maxmin(1, num);
 printf ("Maximum element in an array : %d\n", max);
 return 0;
}
```

OUTPUT:

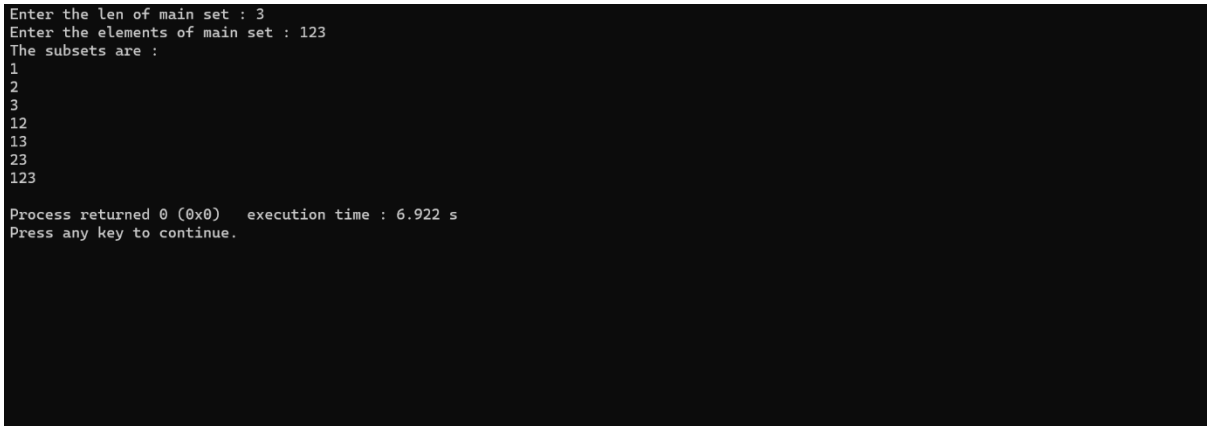
1) THE GIVEN SET SUBSETS OF

PROGRAM:

```
#include <stdio.h>
char string[50], n;
void subset(int, int, int);
 int main()
{
   int i, len;
   printf("Enter the len of main set : ");
   scanf("%d", &len);
   printf("Enter the elements of main set : ");
   scanf("%s", string);
   n = len;
   printf("The subsets are :\n");
   for (i = 1;i <= n;i++)
      subset(0, 0, i);
}
void subset(int start, int index, int num_sub)
```

```
{
   int i, j;
   if (index - start + 1  ==  num_sub)
   {
      if (num_sub  ==  1)
      {
         for (i = 0;i < n;i++)
            printf("%c\n", string[i]);
      }
      else
      {
         for (j = index;j < n;j++)
         {
            for (i = start;i < index;i++)
               printf("%c", string[i]);
            printf("%c\n", string[j]);
         }
         if (start != n - num_sub)
            subset(start + 1, start + 1, num_sub);
      }
   }
   else
   {
      subset(start, index + 1, num_sub);


   }

}
```

OUTPUT:



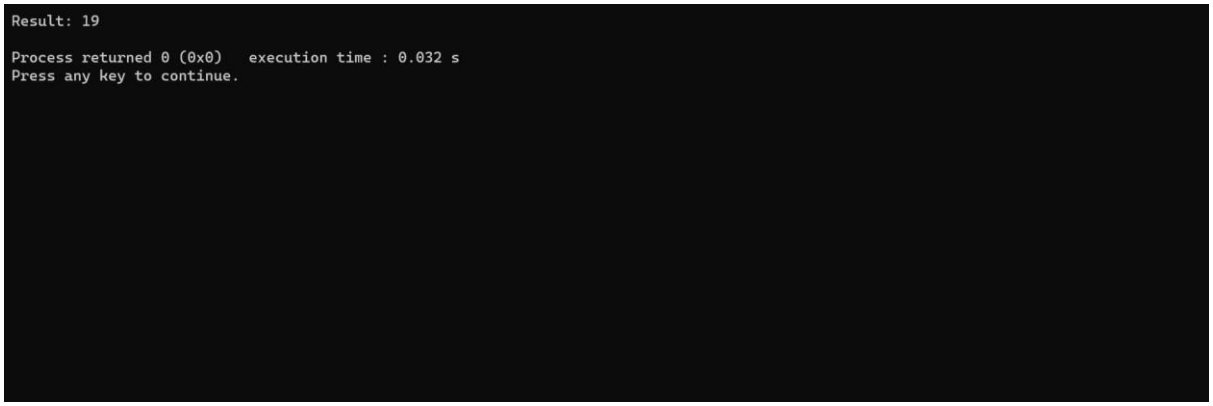
2) CONTAINER LOADING PROBLEM

PROGRAM:

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

#define MAX_ITEMS 100
#define MAX_WEIGHT 100

int weight[MAX_ITEMS];
int value[MAX_ITEMS];
int dp[MAX_ITEMS][MAX_WEIGHT];

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

int knapsack(int n, int w) {
  int i, j;
  for (i = 0; i <= n; i++) {
    for (j = 0; j <= w; j++) {
      if (i == 0 || j == 0) {
        dp[i][j] = 0;
```

```
    } else if (weight[i-1] <= j) {
      dp[i][j] = max(value[i-1] + dp[i-1][j-weight[i-1]], dp[i-1][j]);
    } else {
      dp[i][j] = dp[i-1][j];
    }
   }
  }
  return dp[n][w];
}

int main() {
  int n = 4;
  int w = 10;
  weight[0] = 1;
  weight[1] = 2;
  weight[2] = 4;
  weight[3] = 5;
  value[0] = 5;
  value[1] = 4;
  value[2] = 6;
  value[3] = 8;
  int result = knapsack(n, w);
  printf("Result: %d\n", result);
  return 0;
}
```

OUTPUT:



3) MINIMUM SPANNING TREE WITH PRIMS ALGORITHM

PROGRAM:

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

#define V 5

int minKey(int key[], bool mstSet[]) {
   int min = INT_MAX, minIndex;
   for (int v = 0; v < V; v++)
      if (mstSet[v] == false && key[v] < min)
         min = key[v], minIndex = v;
   return minIndex;
}

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

void primMST(int graph[V][V]) {
```

```
  int parent[V];
  int key[V];
  bool mstSet[V];
  for (int i = 0; i < V; i++)
    key[i] = INT_MAX, mstSet[i] = false;
  key[0] = 0;
  parent[0] = -1;
  for (int count = 0; count < V - 1; count++) {
    int u = minKey(key, mstSet);
    mstSet[u] = true;
    for (int v = 0; v < V; v++)
      if (graph[u][v] && mstSet[v] == false && graph[u][v] < key[v])
        parent[v] = u, key[v] = graph[u][v];
  }
  printMST(parent, graph);
}

int main() {
  int graph[V][V] = {{0, 2, 0, 6, 0},
                     {2, 0, 3, 8, 5},
                     {0, 3, 0, 0, 7},
                     {6, 8, 0, 0, 9},
                     {0, 5, 7, 9, 0}};
  primMST(graph);

}
```

OUTPUT:

```
Edge    Weight
0 - 1   2
1 - 2   3
0 - 3   6
1 - 4   5

--------------------------------
Process exited after 0.05377 seconds with return value 0
Press any key to continue . . .
```

6)N-QUEENS PROBLEM

PROGRAM:

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

#define N 8

int col[N];

bool check(int row) {
  int i;
  for (i = 0; i < row; i++)
    if (col[i] == col[row] ||
        row - i == col[row] - col[i] ||
        row - i == col[i] - col[row])
      return false;
  return true;
}

void backtrack(int row) {
  int i;
  if (row == N) {
```

```
    for (i = 0; i < N; i++) printf("(%d, %d)\n", i, col[i]);
    printf("\n");
    return;
  }
  for (i = 0; i < N; i++) {
    col[row] = i;
    if (check(row)) backtrack(row + 1);
  }
}

int main() {
  backtrack(0);
  return 0;
}
```

OUTPUT:

O

7)TRAVELSALES MAN PROBLEM

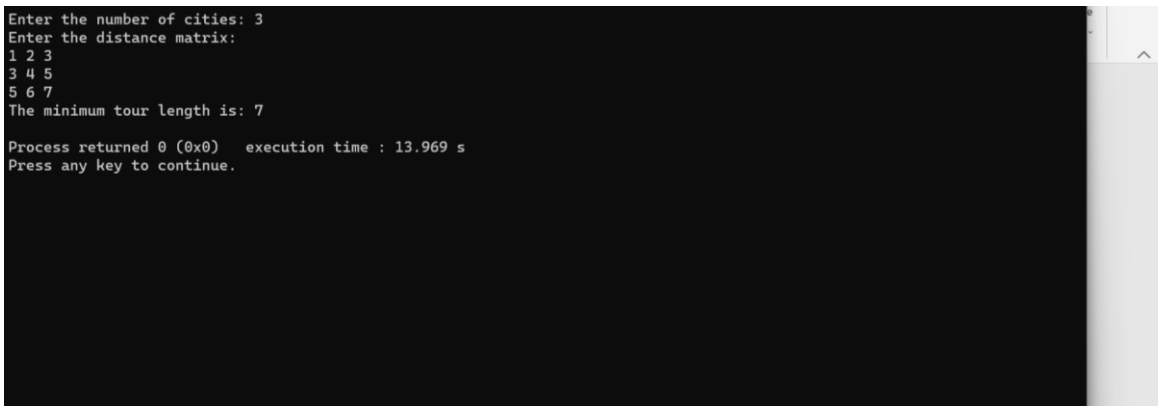
PROGRAM:

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

```
#include <stdbool.h>

#define MAX 20
#define INF 99999

int n, d[MAX][MAX], x[MAX];
int best_tour_length = INF, tour_length[MAX];

void backtrack(int curr_pos) {
  int i;
  if (curr_pos == n) {
    tour_length[curr_pos] = d[x[n - 1]][x[0]];
    int tour = 0;
    for (i = 0; i < n; i++) tour += tour_length[i];
    if (tour < best_tour_length) best_tour_length = tour;
    return;
  }
  for (i = 0; i < n; i++) {
    if (x[i] == -1) {
      x[i] = curr_pos;
      tour_length[curr_pos] = d[x[curr_pos - 1]][i];
      backtrack(curr_pos + 1);
      x[i] = -1;
    }
  }
}

int main() {
  int i, j;
```

```
 printf("Enter the number of cities: ");
 scanf("%d", &n);
 printf("Enter the distance matrix:\n");
 for (i = 0; i < n; i++)
  for (j = 0; j < n; j++) {
   scanf("%d", &d[i][j]);
   x[i] = -1;
  }
 x[0] = 0;
 backtrack(1);
 printf("The minimum tour length is: %d\n", best_tour_length);
 return 0;
}
```

OUTPUT:



8) KNAPSACK USING DYNAMIC PROGRAMMING

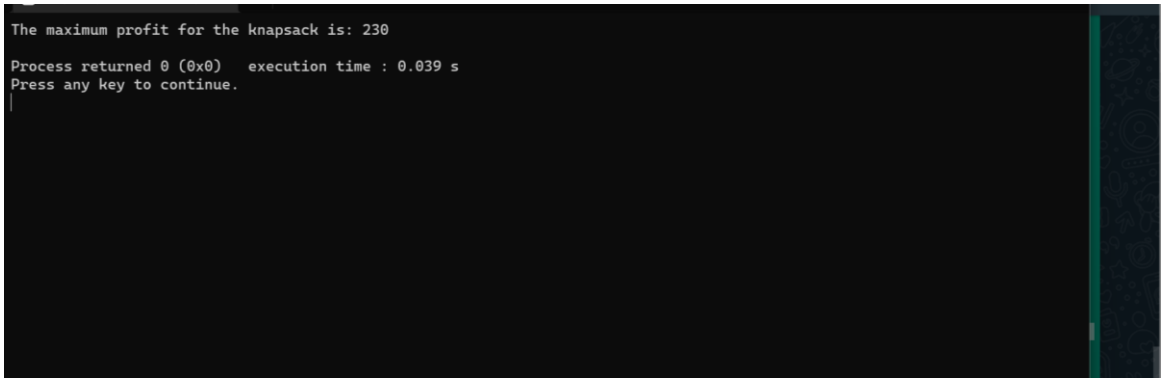
PROGRAM:

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

#define MAX_WEIGHT 100
```

```
// Struct to represent an item
struct Item {
  int weight;
  int profit;
};

// Function to find the maximum profit for the knapsack
int knapsack(struct Item items[], int n, int weight) {
  int dp[n + 1][weight + 1];

  for (int i = 0; i <= n; i++) {
    for (int w = 0; w <= weight; w++) {
      if (i == 0 || w == 0) {
        dp[i][w] = 0;
      } else if (items[i - 1].weight <= w) {
        dp[i][w] =
            fmax(dp[i - 1][w], dp[i - 1][w - items[i - 1].weight] + items[i - 1].profit);
      } else {
        dp[i][w] = dp[i - 1][w];
      }
    }
  }

  return dp[n][weight];
}

int main() {
  struct Item items[] = {{40, 80}, {30, 70}, {20, 50}, {30, 80}};
  int n = sizeof(items) / sizeof(items[0]);
```

```
  int weight = MAX_WEIGHT;

  printf("The maximum profit for the knapsack is: %d\n", knapsack(items, n, weight));

  return 0;
}
```

OUTPUT:



9)OPTIMAL BINARY SEARCH TREE

PROGRAM:

```
// A naive recursive implementation of optimal binary
// search tree problem
#include <stdio.h>
#include <limits.h>

// A utility function to get sum of array elements
// freq[i] to freq[j]
int sum(int freq[], int i, int j);

// A recursive function to calculate cost of optimal
```

```
// binary search tree
int optCost(int freq[], int i, int j)
{
// Base cases
if (j < i)  // no elements in this subarray
        return 0;
if (j == i)           // one element in this subarray
        return freq[i];

// Get sum of freq[i], freq[i+1], ... freq[j]
int fsum = sum(freq, i, j);

// Initialize minimum value
int min = INT_MAX;

// One by one consider all elements as root and
// recursively find cost of the BST, compare the
// cost with min and update min if needed
for (int r = i; r <= j; ++r)
{
        int cost = optCost(freq, i, r-1) +
                                optCost(freq, r+1, j);
        if (cost < min)
                min = cost;
}

// Return minimum value
return min + fsum;
}
```

```
// The main function that calculates minimum cost of
// a Binary Search Tree. It mainly uses optCost() to
// find the optimal cost.
int optimalSearchTree(int keys[], int freq[], int n)
{
        // Here array keys[] is assumed to be sorted in
        // increasing order. If keys[] is not sorted, then
        // add code to sort keys, and rearrange freq[]
        // accordingly.
        return optCost(freq, 0, n-1);
}

// A utility function to get sum of array elements
// freq[i] to freq[j]
int sum(int freq[], int i, int j)
{
        int s = 0;
        for (int k = i; k <=j; k++)
        s += freq[k];
        return s;
}

// Driver program to test above functions
int main()
{
        int keys[] = {10, 12, 20};
        int freq[] = {34, 8, 50};
        int n = sizeof(keys)/sizeof(keys[0]);
```

```
        printf("Cost of Optimal BST is %d ",
                        optimalSearchTree(keys, freq, n));
        return 0;
}
```

OUTPUT:

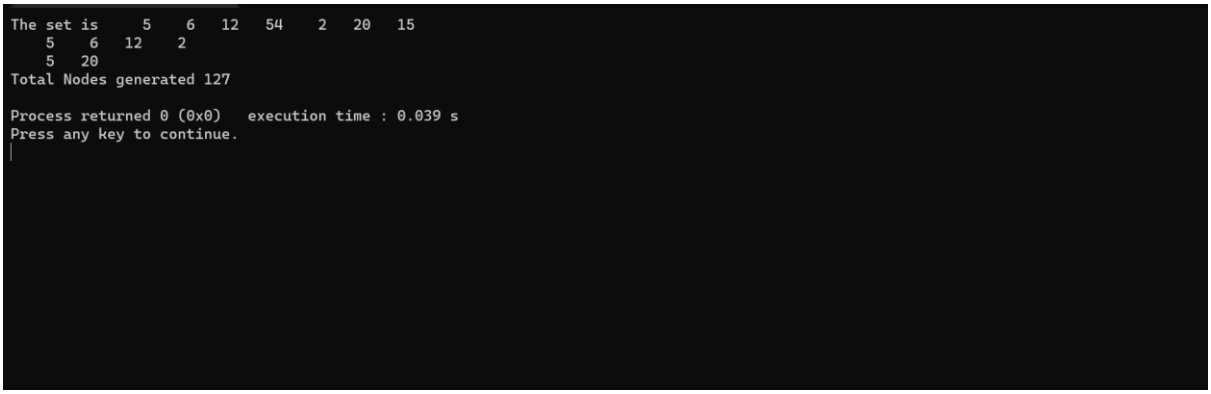
10)SUM OF SUBSETS USING BACK TRACKING

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
static int total_nodes;
void printValues(int A[], int size){
  for (int i = 0; i < size; i++) {
    printf("%*d", 5, A[i]);
  }
  printf("\n");
}
void subset_sum(int s[], int t[], int s_size, int t_size, int sum, int ite, int const target_sum){
  total_nodes++;
  if (target_sum == sum) {
    printValues(t, t_size);
```

```
    subset_sum(s, t, s_size, t_size - 1, sum - s[ite], ite + 1, target_sum);
    return;
  }
  else {
    for (int i = ite; i < s_size; i++) {
      t[t_size] = s[i];
      subset_sum(s, t, s_size, t_size + 1, sum + s[i], i + 1, target_sum);
    }
  }
}
void generateSubsets(int s[], int size, int target_sum){
  int* tuplet_vector = (int*)malloc(size * sizeof(int));
  subset_sum(s, tuplet_vector, size, 0, 0, 0, target_sum);
  free(tuplet_vector);
}
int main(){
  int set[] = { 5, 6, 12 , 54, 2 , 20 , 15 };
  int size = sizeof(set) / sizeof(set[0]);
  printf("The set is ");
  printValues(set , size);
  generateSubsets(set, size, 25);
  printf("Total Nodes generated %d\n", total_nodes);
  return 0;
}
```

OUTPUT:



11)MINIMUM SPANNING TREE USING GREEDY TECHNIQUES

PROGRAM:

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

#define V 5

int minKey(int key[], int mstSet[]) {
   int min = INT_MAX, min_index;
   int v;
   for (v = 0; v < V; v++)
      if (mstSet[v] == 0 && key[v] < min)
         min = key[v], min_index = v;

   return min_index;
}

int printMST(int parent[], int n, int graph[V][V]) {
   int i;
   printf("Edge   Weight\n");
   for (i = 1; i < V; i++)
```

```
        printf("%d - %d    %d \n", parent[i], i, graph[i][parent[i]]);
}

void primMST(int graph[V][V]) {
    int parent[V]; // Array to store constructed MST
    int key[V], i, v, count; // Key values used to pick minimum weight edge in cut
    int mstSet[V]; // To represent set of vertices not yet included in MST

    // Initialize all keys as INFINITE
    for (i = 0; i < V; i++)
        key[i] = INT_MAX, mstSet[i] = 0;

    // Always include first 1st vertex in MST.
    key[0] = 0; // Make key 0 so that this vertex is picked as first vertex
    parent[0] = -1; // First node is always root of MST

    // The MST will have V vertices
    for (count = 0; count < V - 1; count++) {
        int u = minKey(key, mstSet);
        mstSet[u] = 1;

        for (v = 0; v < V; v++)

            if (graph[u][v] && mstSet[v] == 0 && graph[u][v] < key[v])
                parent[v] = u, key[v] = graph[u][v];
    }

    // print the constructed MST
    printMST(parent, V, graph);
```

```
}

int main() {
   /* Let us create the following graph
    2   3
   (0)--(1)--(2)
    |   / \   |
   6| 8/   \5 |7
    | /     \ |
   (3)-------(4)
    9         */
   int graph[V][V] = { { 0, 2, 0, 6, 0 }, { 2, 0, 3, 8, 5 },
         { 0, 3, 0, 0, 7 }, { 6, 8, 0, 0, 9 }, { 0, 5, 7, 9, 0 }, };


   primMST(graph);


   return 0;
}
```

OUTPUT: