Project Report
MAT1003 - D Slot

Title: Submarine cable route planner
Group: G7

Group members:

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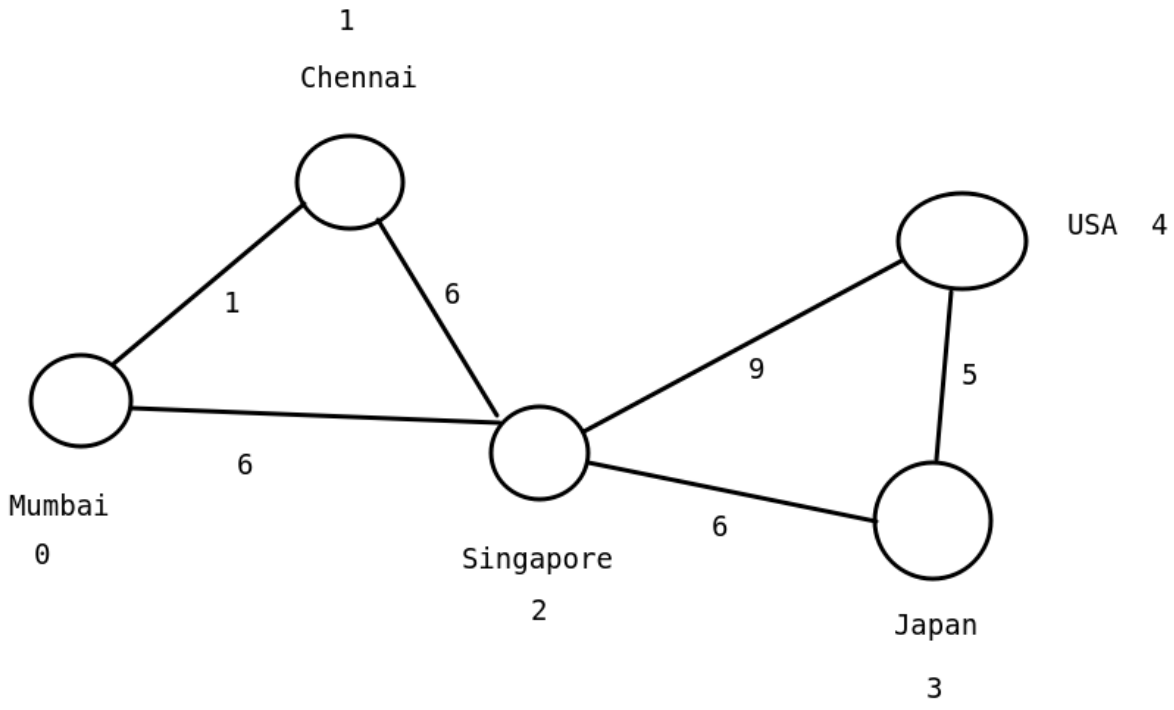
Map visualization:



matrix.txt:

0 1 6 0 0
1 0 6 0 0
6 6 0 6 9
0 0 6 0 5
0 0 9 5 0

Output:

▾ Running code

```
[ ]   !java RouteFinder.java
```

```
            0 - Mumbai
            1 - Chennai
            2 - Singapore
            3 - Japan
            4 - USA

      Enter your target: 3

           Vertex              Distance       Path
      0 -> 1 Chennai           1              0 - 1 -
      0 -> 2 Singapore                 6              0 - 2 -
      0 -> 3 Japan             12             0 - 2 - 3 - <---- target found
      0 -> 4 USA               15             0 - 2 - 4 -
```

Code:

```
import java.util.*;
import java.io.File;

class RouteFinder   {
   static int[][] arr;
```

```
    public static void main(String[] args)  {
        boolean success = read_data();
        if (!success)
            return;

        // add nodes to hashmap
        HashMap<Integer, String> hm = new HashMap<Integer,
String>();
        hm.put(0, "Mumbai");
        hm.put(1, "Chennai");
        hm.put(2, "Singapore");
        hm.put(3, "Japan");
        hm.put(4, "USA");
        System.out.println("");

        // display all nodes from hashmap
        for (int num: hm.keySet())  // display node
            System.out.println("\t" + num + " - " + hm.get(num));
        System.out.println("");

        // take input for target
        Scanner scan = new Scanner(System.in);
        System.out.print("Enter your target: ");
        int target = scan.nextInt();

        DijkstrasAlgorithm d = new DijkstrasAlgorithm();
        d.process(target, arr, hm);
        System.out.println("");
    }
    static boolean read_data() {
        try {
            Scanner sc = new Scanner(new File("matrix.txt"));
            int rows = 0;
            while (sc.hasNextLine()) {
```

```
                rows++;  // count rows
                sc.nextLine();
            }
            sc.close();
            int columns = rows;
            arr = new int[rows][columns];

            // read integers from file
            sc = new Scanner(new File("matrix.txt"));
            for (int row = 0; row < rows; row++)
                for (int col = 0; col < columns; col++)
                    // if (sc.hasNextInt())
                    arr[row][col] = sc.nextInt();
            sc.close();

            return true;
        } catch (Exception e) {
            System.out.println("Sorry... matrix file not found");
            return false;
        }
    }
}


class DijkstrasAlgorithm {

static int NO_PARENT = -1;
static HashMap<Integer, String> hm;
static int target_node;

static void process(int target1, int[][] matrix,
HashMap<Integer, String> hm1)   {
   target_node = target1;
   hm = hm1;
```

```
    int numNodes = matrix.length;
    if (target1 <= 0 || target1 >= numNodes)
        System.out.println("\t Target " + target1 + " can't be
found");
    dijkstra(matrix, 0);
}  //

static void dijkstra(int[][] matrix, int startNode)  {
    int numNodes = matrix[0].length;

    // shortest distance from src to i
    int[] shortestDists = new int[numNodes];

    // added[i] =true if node i is
    // included in shortest path
    // or shortest distance from src to
    // i is finalized
    boolean[] added = new boolean[numNodes];

    for (int nodeIndex = 0;
            nodeIndex < numNodes; nodeIndex++) {
        shortestDists[nodeIndex] = Integer.MAX_VALUE;  // init as
infinite
        added[nodeIndex] = false;
    }

    // Distance of startNode from itself = 0
    shortestDists[startNode] = 0;
    int[] parentArr = new int[numNodes];  // store shortest path
    parentArr[startNode] = NO_PARENT;  // startNode has no parent

    // Find shortest path for all vertices
    for (int i = 1; i < numNodes; i++) {
```

```
        // Pick the minimum distance node
        // from the set of unprocessed vertices.
        // nearestNode is always equal
        // to startNode in first iteration.
        int nearestNode = -1;
        int shortestDist = Integer.MAX_VALUE;
        for (int nodeIndex = 0; nodeIndex < numNodes;
                nodeIndex++)  {
            if (!added[nodeIndex]
                    && shortestDists[nodeIndex] <
                    shortestDist) {
                nearestNode = nodeIndex;
                shortestDist = shortestDists[nodeIndex];
            }
        }

        // Mark the picked node as processed
        added[nearestNode] = true;

        // Update dist value of the adjacent
        // vertices of the picked node.
        for (int nodeIndex = 0; nodeIndex < numNodes;
nodeIndex++) {
            int edgeDistance = matrix[nearestNode][nodeIndex];

            // if current shortest dist < existing shortest dist,
update array
            if (edgeDistance > 0
                    && (shortestDist + edgeDistance <
                    shortestDists[nodeIndex])) {
                parentArr[nodeIndex] = nearestNode;
                shortestDists[nodeIndex] =
                        shortestDist + edgeDistance;
            }
```

```
        }
    }
    printSolution(startNode, shortestDists, parentArr);
}

static void printSolution(int startNode,
                          int[] distances,
                          int[] parentArr)   {
    int numNodes = distances.length;
    System.out.print("\n     Node\t\t Distance\tPath");

    for (int nodeIndex = 0;
                nodeIndex < numNodes; nodeIndex++)   {
        if (nodeIndex != startNode)   {
            System.out.print("\n" + startNode);
            System.out.print(" -> " + nodeIndex + " ");
            System.out.print(hm.get(nodeIndex) + " \t\t ");
            System.out.print(distances[nodeIndex] + "\t\t");
            printShortestPath(nodeIndex, parentArr);
            if (target_node == nodeIndex)
                System.out.print("<---- target found");
        }
    }
}

static void printShortestPath(int curNode, int[] parentArr) {
    // Source node has been processed
    if (curNode == NO_PARENT)
        return;
    printShortestPath(parentArr[curNode], parentArr);
    System.out.print(curNode + " - ");
}
}
```

Project Synopsis

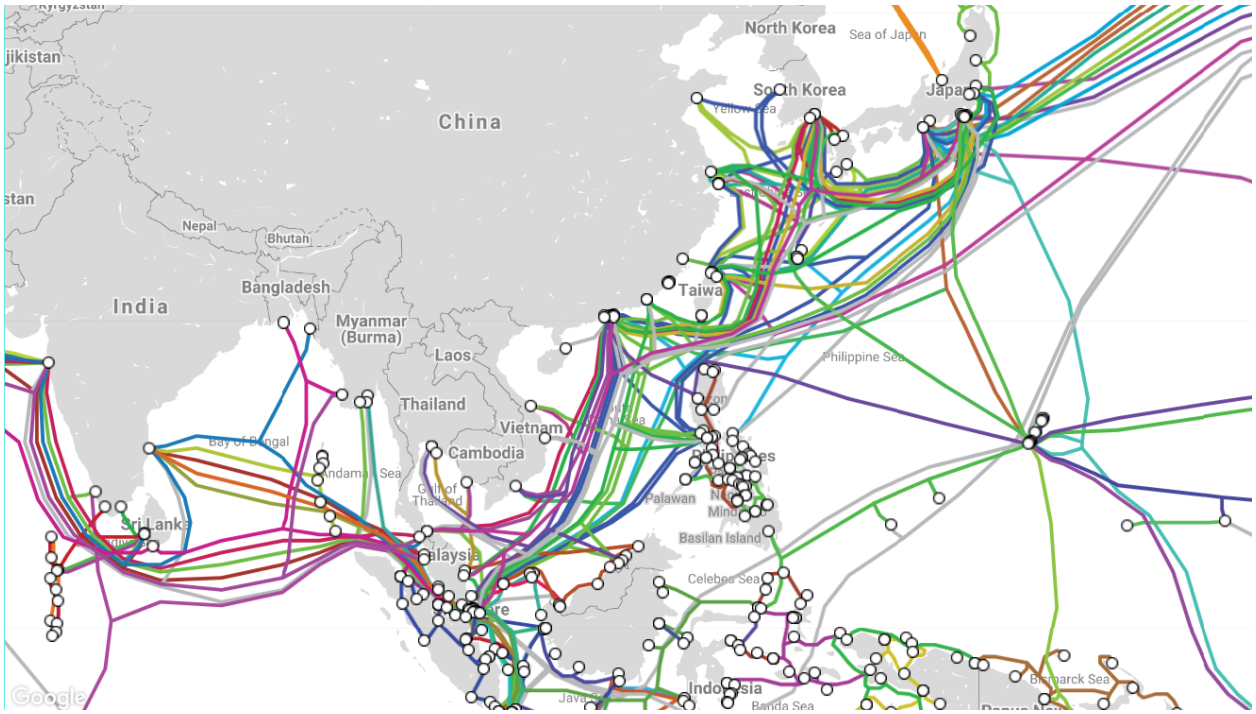
Objectives:

To help the networking companies manage the routes in an efficient way to save the operating costs, and send data in a minimal amount of time.

Methodology:

Map data is entered into text files. We use Dijkstra's algorithm to find the route. The algorithm finds the shortest path between the mentioned source and destination which is entered by the user.
Code is uploaded to GitHub repository:
https://github.com/vh-praneeth/Submarine_cable_route

Map screenshot:



Other parts from Project Proposal document

Abstract:

We need to send data from our computer to a different server using the internet. It is sent to different countries through Submarine cables which are installed in the sea.

The cables route about 99% of global internet traffic. These cables are also called Undersea cables.

There are many possible paths using which we can send data. Each cable has a different capacity and different amount of other traffic which is currently being sent. Cable map is available on the website: https://www.submarinecablemap.com/.

Expected Outcome:

Using this project, we write an algorithm that finds the best path to send the data to the destination, with the minimum distance possible.