

# Data Structure

## Homework 4

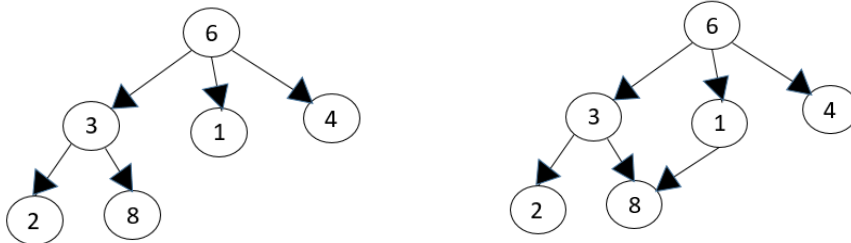
Deadline: **2019/12/31 23:55**

### Task1: (I/O: 25 points, coding style: 5 points)

A tree is defined as null(empty, void, nothing), or it is composed of one or more nodes and directed edges. A tree should have the following conditions:

- There is only one point, which we call root, without any side pointing at him.
- Nodes other than the root have only one edge pointing at him.
- There is only one path from the root to any node.

For example, consider the illustrations below, in which nodes are represented by circles and edges are represented by lines with arrowheads. The one in the left-hand side is a tree, however, the one in the right-hand side is not a tree.



Please write a program to input multiple sets of test data. Each group of test data represents a figure, and the content is edge data. Each directed edge is represented by two integers  $i, j$  that are greater than 0. The two integers are the number of the nodes, which represent a directed edge from  $i$  node to  $j$  node. The 0 0 edge represents the end of this set of input data. The two consecutive -1 represent the end of the entire input.

The output: For each test case display the line 'Case  $k$  is a tree.' or the line 'Case  $k$  is not a tree.', where  $k$  corresponds to the test case number.

### Example:

Input	Output
6 3 6 1 6 4 3 2 3 8 0 0	Case 1 is a tree.
6 3 6 1 6 4 3 2 1 8 3 8 0 0	Case 2 is not a tree.
-1 -1	

**Task2: Minimum Spanning Tree: Prim's Algorithm (I/O: 15 points, coding style: 5 points)**

Given graphs represented by adjacency matrices, please implement Prim's Algorithm and build the minimum spanning tree starting from vertex A. The first line will be the number of vertices. Vertices are labeled alphabetically using the letters A-Z. The distance between any two vertices will not exceed 100,000. The output shows the "Minimum cost: ". If the graph is not connected, you need to print "NO connected". It should be noted that -1 is the end of the input.

**Example:**

Input	Output
4 0 4 9 21 4 0 8 17 9 8 0 16 21 17 16 0	Minimum cost:28
4 0 5 0 0 5 0 6 0 0 6 0 0 0 0 0 0  -1	NO connected

**Task3: Minimum Spanning Tree: Kruskal Algorithm (I/O: 35 points, coding style: 5 point)**

Please write a program to input multiple sets of test data. Enter a positive integer n, which means that there are n cities, and then there are n rows. Each row has two values, which represent the X and Y coordinate values of the plane where a city is located. The coordinate values can be floating point numbers. Output the shortest distance of roads connecting n cities.

**Example:**

Input	Output
5 0.0 0.0 2.0 2.0 4.0 3.0 5.0 5.0 2.0 5.0	The shortest distance=10.129
3 0.0 0.0 1.0 1.0 5.5 6.5	The shortest distance=8.52055

Put the files below in the folder (folder name: studentID), and compress this folder as **“studentID.zip”**

1. **Two** source code files (filename: studentID\_1.c, studentID\_2.c)
2. **One report** with your coding environment (OS, IDE, ...), problems you encountered, and references. (filename: studentID.pdf) (10 points)

All the file names are correct, or you'll get zero points. (5 points)

**You must hand in the assignment on time, or you will get zero points.**

**Warning:** We encourage you to discuss assignments with each other. However, you have the responsibility to finish the assignments individually. **Do not copy others' assignment, or you will get zero points.**

**Expected result:**

(1)

```
C:\Users\dblab\Desktop\C_language\tree\bin\Debug\tree.exe
6 3 6 1 6 4 3 2 3 8 0 0
Case 1 is a tree.
6 3 6 1 6 4 3 2 1 8 3 8 0 0
Case 2 is not a tree.
-1 -1

Process returned 0 (0x0)   execution time : 0.747 s
Press any key to continue.
```

(2)

```
C:\Users\dblab\Desktop\C_language\debug\main.exe
4
0 4 9 21
4 0 8 17
9 8 0 16
21 17 16 0
Minimum cost:28
4
0 5 0 0
5 0 6 0
0 6 0 0
0 0 0 0
NO connected
-1
Process returned 0 (0x0)   execution time : 0.142 s
Press any key to continue.
```

(3)

```
C:\Users\dblab\Desktop\C_language\mst\main.exe
5
0.0 0.0
2.0 2.0
4.0 3.0
5.0 5.0
2.0 5.0
The shortest distance=10.129
3
0.0 0.0
1.0 1.0
5.5 6.5
The shortest distance=8.52055
```