Data Structure Assignment 4

Task 1 : Merge Sort (I/O: 15 points, coding style: 5 points)

Given an input number `n` and serial integers, please sort the integers by **merge sort**.

- Input Format:
  - The first line represents the amount of the input series. (a variable `n`)
  - Starting from the second line, each line represents a serial input numbers to be sorted.
  - All inputs end with a new line "`\n`".
  - The number of input numbers is smaller than 30000.
  - The numbers in a serial input are integers ($-2^{31} < \text{number} < 2^{31} - 1$), and they are separated by a comma (",").

- Output Format:
  - There's no white space at the front.
  - One white space between the output numbers, and no white space but a new line "`\n`" at the end.

Example:

Input	output
2 9,5,6,7,1,8,3 22,86,-5,8,66,9	1 3 5 6 7 8 9 -5 8 9 22 66 86

Task2 : Minimum Spanning Tree: Prim's Algorithm (I/O: 25 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.

- Input Format:
  - The first line will be the number of cases.
  - Each case begins with the number of vertices.
  - Vertices are labeled alphabetically using the letters `A-Z`.
  - The subsequent lines contain the distances between vertices, the distances are integers (-2^{31} < number < $2^{31}-1$).
  - If the distance is a value of zero, it implies no edge between the two vertices.

- Output Format:
  - The output shows the edges between vertices and the distances between two vertices.

Example:

Input	output
2 4 0,1,0,4 1,0,3,2 0,3,0,5 4,2,5,0 6 0,7,9,0,0,6 7,0,0,2,0,0 9,0,0,0,5,0 0,2,0,0,0,3 0,0,5,0,0,4 6,0,0,3,4,0	Case 1: A-B 1 B-D 2 B-C 3 Case 2: A-F 6 F-D 3 D-B 2 F-E 4 E-C 5

Task3 : Minimum Spanning Tree: Practical Problems (I/O: 30 points, coding style: 5 points)

In the country of DSland, there are many cities but no roads. The federal government wants to change this situation and plans to build roads and railroads such that all the cities in the country are connected through this new transportation system. To make the new system more efficient, DSland will build only roads between cities within the same state and will use railroads to connect cities that are in different states. For the purposes of this problem, consider that if the distance between any two cities is at most r then they are in the same state. To minimize the costs of building the roads and railroads, the government also wants to build only the minimum necessary extension of roads and railroads such that there is a path between any pair of cities in the entire country. You've been hired to determine what's the optimum transportation network system that DSland must build. The first line of the input contains the number of test cases that follow. On the first line of each test case, there will be two integers, n ($1 \le n \le 1000$), the number of cities that comprise DSland, and r ($0 \le d \le 40000$), the threshold value to determine if two cities are in the same state. On the following n lines, there will be a list of x − y ($-10000 \le x, y \le 10000$) integer coordinates in the plan for each city in DSland. Your program must output the number of states in DSland and the minimum extension (rounded to the nearest integer) of both roads and railroads that must be built to satisfy the conditions of the project.

- Input Format:
  - The first line of input gives the number of cases, **T** ($1 \le T \le 20$). **T test cases** follow.
  - On the first line of each test case, there will be two integers, **n** ($1 \le n \le 1000$), **the number of cities** that comprise DSland, and **d** ($0 \le d \le 40000$), **the threshold value** to determine if two cities are in the same state.
  - On the following n lines, there will be a list of x − y ($-10000 \le x, y \le 10000$) integer coordinates in the plan for each city in DSland.
- Output Format:
  - The output is comprised of one line for each input data set.
  - The line identifies the data set with a number (starting from one and incrementing at each new data set), followed by the **number of states** in DSland and the **minimum extension** (rounded to the nearest integer) of both **roads** and **railroads** that must be built to satisfy the conditions of the project.

Note: Notice that, by the definition, if A and B are in the same state, and B and C are in the same state, then A and C are also in the same state.

Example:

Input	output
3 3 100 0 0 1 0 2 0 3 1 0 0 100 0 200 0 4 20 0 0 40 30 30 30 10 10	Case 1: 1 2 0 Case 2: 3 0 200 Case 3: 2 24 28

Note:

- You must use **C** as your programming language.

[Good coding styles]

- A clear main() function with few nested structures (if-else)
- Meaningful variable names and no global variables
- No fake functions or declaring similar functions doing the same thing
- No warnings after compiling

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

1. Three source code file. (filename: studentID_1.c, studentID_2.c, studentID_3.c)
2. One **report** with your coding environment (OS, IDE, …), problems you encountered, and references (websites, friends who taught you, …). (filename: studentID.pdf) **(10 points)**

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

Deadline: 2019/1/1 23:59. **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 all of you will get zero points.