COMP 202 - Spring 2021 - Homework #4 Part I

Due date: Sunday, May 16 at 23:59

HW Description:

This is a two-part assignment, in which you are going to implement 2 graph algorithms:

1. Minimum spanning tree (MST)
2. Shortest path

In this part you will have to implement an MST algorithm of your choice. Note that it will also be used in Part II of this homework. The MST algorithms you are advised to choose from are:

1. Prim's algorithm
2. Kruskal's algorithm

In this assignment, you will solve several real world network planning problems by mapping them to well-known graph algorithms mentioned above. Using the network planning problem gives you the opportunity to implement new data structures, such as union-find, and apply previously used data structures, such as heaps/priority queues, on real-world problems. Additionally, this assignment comes with more freedom than previous ones, meaning you can choose whichever data-structures you feel appropriate for solving the problem presented.

If needed, additional information on union-find can be found in this video.

The tasks to solve:

You will be given a text input in form given below (the headers won't be included, the columns will be separated by spaces)

Network Point A	Network Point B	Cost (millions of dollars)	Latency (milliseconds)
ibm.com	yahoo.com	20	33
yahoo.com	ucsd.edu	19	40
ucsd.edu	ibm.com	10	17
yahoo.com	fsf.org	5	10

Parsing the input will be done for you, so you can start working on an adjacency matrix representation of a graph. You are free to convert it further to any other form you feel more comfortable to use (like adjacency list or edge list).

Given the inputs, your task is to output the following:

1. The total cost of building all of the possible network links. This is the sum of all the values in column three of your input data.
2. The total cost of building the cheapest network that will permit packets to travel from any computer to any other. This is generated by first creating a minimum spanning tree where the edges connecting links are chosen based on the cheapest edge. Then summing all the edge costs of the tree.
3. The amount of money saved by building the minimum-cost network instead of the all-possible-links network. This is the difference between your output from line two and line one.

For example, given the input above, the output would be:

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54
34
20
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Submission Materials:
In all homeworks, you are required to submit two things:

- A pdf file with your pseudocode and asymptotic complexity analysis (time and space). If it is handwritten, make sure it is legible.
- A java implementation that compiles and runs without additional setup (submitted through github classroom **and** via Blackboard).

In your pdf file, you must copy-paste the following statements exactly, and sign it by hand. You can use your phone camera for that. Without this signed statement, your submission will not receive any grade.

I have completed this assignment individually, without support from anyone else. I hereby accept that only the below listed sources are approved to be used during this assignment:

(i) Course textbook,

(ii) All material that is made available to me by the professor (e.g., via Blackboard for this course, course website, email from professor / TA),

(iii) Notes taken by me during lectures.

I have not used, accessed or taken any unpermitted information from any other source. Hence, all effort belongs to me.

Github Submission:

Usage of github classroom and submission details:

1) Accept the invitation using this link (https://classroom.github.com/a/N9XxNaCo)
2) Choose your student ID from the list, it will be linked to your github account from now on.
3) A personal repository with the starter code will be created. You can directly edit the code on github's page, clone it to your local storage and edit it there, or use the online IDE Repl.it.
4) Make sure your changes are committed and pushed to the repository.
5) Check if you have successfully passed the tests in the "Actions" tab of your repository. Note that these automatic tests help you understand whether or not your solution works up to some level, but passing them does not guarantee that you will receive a full grade.
6) To make sure your code is received and avoid any potential problems on github's side, submit a copy of java files together with the above-mentioned pdf on Blackboard as well. Submit all files as a single .zip file, named as: "ID_NAME_SURNAME.zip"