BLG 336E - Analysis of Algorithms II , Spring 2015

Project 2

Total Worth : 10% of your grade

Handed Out : 30.03.2015 Monday

Due : 13.04.2015 Monday- 23:00

Overview

You are an investor with millions of dollars and you want to establish a telecom company called The ITU Telecom. You would have many exchange destinations (Ex. 8 cities). However, the problem is, it would be impossible to connect all cities directly due to high wiring costs. So, you would like to build your telecom network in such a way that it is still possible to connect from each city to every other city, minimizing the total cost of your network. How would you set up your network? Also, The ITU Telecom would have to setup a head office in a most "central" city. Where can the head office be built in?

Q1) [10 points] How would you model this problem?

Q1a) [4 points] Which algorithm(s) we have seen in the class could be used and how, in order to solve the problem of: "build your telecom network in such a way that it is still possible to connect from each city to every other, minimizing the total cost of your network. How would you set up your network?" **(Algorithm 1a)**

Q1b) [6 points] Which algorithm(s) we have seen in the class could be used and how, in order to solve the problem of: "The ITU Telecom would have to setup a head office in a most "central" city. Where can the head office be built in?" Assume that the cost of setting up the connection between two cities and the cost of communication between them is equal. **(Algorithm 1b)**

You need to implement Algorithm 1a and Algorithm 1b in this project.

Code (50 points)

Implement your graph in C++. Write your program in a class called ITUTelecom.

Apply **Algorithm 1a** to the graph, and print the resulting network with **printNetwork()** method [**20 points**] and find the total cost of your network with **findTotalCost()** method [**5 points**].

Also, find the city in which the head office should be built in with **Algorithm 1b**. In order to do this, you need to implement **findCentralCity()** method [**10 points**]. It should return the name of the city in which head office can be built in. Then, find the total cost of communication between the head office and all the other cities with **costToHeadOffice()** method [**10 points]**. You need to create and use data structures mentioned in "**Greedy Algorithms**" slide.

You are given an input file (**input.txt**). It has a structure as:

The first line contains the number of cities.
The second line contains the number of connections.
The remaining lines contain city pairs and the cost of connecting them. (Ex. `4 5 3.5`

You must get an output file that contains;

- ✓ The resulting network (in the city pairs format as in input.txt)
- ✓ Total cost of your network.
- ✓ The city at which the head office built in?
- ✓ The total cost of communication between the head office and all the other cities.

Sample **input.txt** and sample **output.txt** can be found in the project documents.

Your program should compile and run using the following commands:

g++ yourStudentID.cpp –o project2

./project2 input.txt output.txt

Your program will be evaluated with a different input file, with different number of nodes in the graph. Your program should run with any graph.

Report (40 points)

1. **[15 points]** Your program

- ✓ How do your algorithms work? Write your pseudo code.
- ✓ Explain your classes and your methods. What are their purposes?

2. **[15 points]** Show complexities of your algorithms on pseudo-code.

- ✓ **[10 points]** How do you find the resulting network, the total cost of your network, the central city? Explain in details.

Submission

You should be aware that the Ninova system clock may not be synchronized with your computer, watch, or cell phone. Do not e-mail the teaching assistant or the instructors your submission after the Ninova site submission has closed. If you have submitted to Ninova once and want to make any changes to your report, you should do it before the Ninova submission system closes. Your changes will not be accepted by e-mail. Connectivity problems to the Internet or to Ninova in the last few minutes are not valid excuses for being unable to submit. You should not risk leaving your submission to the last few minutes. After uploading to Ninova, check to make sure that your project appears there.

Policy: You may discuss the problem addressed by the project at an abstract level with your classmates, but you should not share or copy code from your classmates or from the Internet. **You should submit your own, individual project.** Plagiarism and any other forms of cheating will have serious consequences, including failing the course.

Submission Instructions: Please submit your homework through Ninova. Please zip and upload all your files using filename HW2_ studentID.rar. In the archived file, you must include your completed report_StudentId file and all your program and header files.

All your code must be written in C++, and we must be able to compile and run on it on ITU's Linux Server (you can access it through SSH) using g++. You should supply one yourStudentID.cpp file that calls necessary routines for all questions (Multiple files are acceptable, as long as you state the compilation instructions in your report).

When you write your code, try to follow an object-oriented methodology with well-chosen variable, method, and class names and comments where necessary**. Your code must compile without any errors; otherwise, you may get a grade of zero on the assignment.**

If a question is not clear, please let the teaching assistant know by email (hakangunduz@itu.edu.tr)