IEOR 4004: Programming assignment 2

The provided dataset "facebook_combined.txt" consists of a **connected** "friends" network from Facebook[1]. The dataset has 4039 nodes, numbered as $0, 1, 2, \ldots, 4038$, representing unique facebook users. Each line in the dataset provides one (undirected) edge in the network, formatted as
a b
representing friendship relation between a and b. (We have provided a Python code snippet "readNetwork.py", which you can use to read the edges of this network into a python dictionary G.).

Now, consider the following problem. Suppose that after an advertisement is shown to any one person in this network, it automatically appears on the walls of all his friends in 1 hour, and then on the walls of the friends of those friends in the next 1 hour, and so on. Therefore, since the network is connected, it will reach everyone at some point in time.

Suppose at 0^{th} hour, I show an ad to user 0. Let us say that the **exposure time** for user i is h, if it takes h hours to appear on the wall of user i for the first time.

Write a script to find the average exposure time over all users in the network

Hint: This can be formulated as solving many shortest path problems, or a single min-cost flow problem (we will study min-cost flow problem on Tuesday Nov 12). Think about how you can compute the time it takes for the ad to go from node 0 to a given node i. You may modify the Python/Gurobi script shortestPath.py to solve it.

Important: Please download all the files/scripts provided with this homework in your local directory where you are working.

Submission Instructions: Please submit your written formulation with explanation and final answers, as well as the code in pdf format. Online submissions through gradescope only.

[1]The data was collected from survey participants using a Facebook app. More details are available here: `https://snap.stanford.edu/data/egonets-Facebook.html`https://snap.stanford.edu/data/egonets-Facebook.html