Network Metrics

In this assignment, you will write a program to compute several network metrics and properties you've learned in the class against a given network. Specifically, the following metrics should be computed and stored in the output file `output.txt` that should be in the following format (values on the same line should be separated by single spaces):

- Line 1: density of the graph (rounded to 5 decimal digits) (5 pts).
- Next line: diameter of the graph (5 pts).
- Next line: number of connected components (5 pts).
- Next line: maximum node degree (5pts).
- Next n lines, where n is the number of nodes in the network: each line i should contain the following two values about node i: node degree centrality and node closeness centrality separated by space (rounded to 5 decimal digits). For this assignment, set the edge weights to 1 for all edges. Moreover, if there is no path between two nodes, their distance should be set to 10^3 (40 pts).
- Next k lines, where k is the number of connected components in the graph: each line i should list all nodes belonging to component i. The nodes in the same component have to be listed in increasing order, and the components have to be listed in increasing order of their first nodes (40 pts)

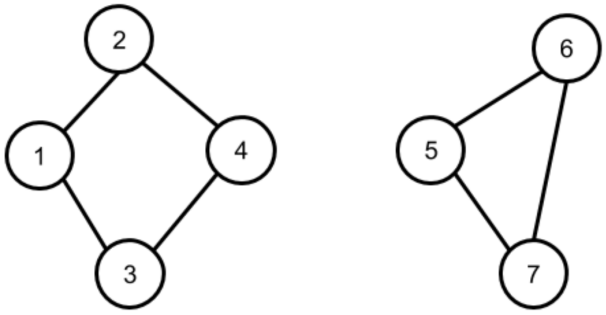

Figure 1: A example graph with two connected components.

For example, given the network in Figure 1, your `output.txt` file should contain:

```
0.33333
2
2
2
0.33333 0.002
0.33333 0.002
0.33333 0.002
0.33333 0.002
0.33333 0.0015
0.33333 0.0015
```

0.33333 0.0015
1 2 3 4
5 6 7

A sample network is provided in this package, see the file `net-sample.txt` in the left menu. You can use this network to run your experiments and make sure the resulting output of your program are in the required format. We will grade your assignment based on a *test* network which is different from the sample network.

Important Notes

You must submit a single zip file named `NAME_STUDENTID.zip` that contains the following three files in its root directory:

1. One script named `compute-metrics` for computing the metrics. You can use any programming language. However, we highly recommend Python.
2. One text file named `output.txt` containing the metrics computed against the input network. This file should be produced by your `compute-metrics` script.
3. One text file named `README.txt` explaining steps to run your program.

We expect your script to be EASY to run. Specifically, if you use Python, we will run this command:

```
$ python compute-metrics.py net-sample.txt
```

If you use C++, we will run these commands:

```
$ g++ compute-metrics.cpp -o compute-metrics -O2 -Wall
$ ./compute-metrics net-sample.txt
```

Also note that:

- The test network will have the same format as the sample network `net-sample.txt`. Your program has to follow this input format.
- Your `output.txt` should be in the exact format as described above. Your file must have $n + k + 4$ lines. Do NOT omit any line; if you don't know how to compute certain lines, use a blank line instead.
- Your Zip file should be submitted to Blackboard before the deadline, otherwise it will be ignored. Please do not email your files.

Good luck with the assignment!