CS4980:0005 PEER-TO-PEER AND SOCIAL NETWORKS
HOMEWORK 2
100 POINTS
ASSIGNED 10/23/15 DUE 11/2/15

Use NetworkX for this homework. For the ease of grading, please use "anaconda' python environment with python 3.4; it is available for all OS. If you do not feel comfortable using it, then use an environment of your choice, but make sure that your submitted programs run fine on Anaconda.

Submit separate program files for each part of HW. Include a readme file to help the reader run your programs. It is important that for Parts 1 and 2, all the outputs are (printout or graphs) are generated one after the other with a single run of the program, without any need to change any parameter or enter any argument, or uncomment any part of the program. Also, for each part, submit the codes, and the output or the results as appropriate.

The problem

Repeat the Small World experiment [1] originally done by Watts and Strogatz. The paper is available in the list of readings, and we discussed this paper in the class. Here is what you need to do.

Part 1 (30 points): Construct a ring topology with n=5000 nodes. Assign identifiers 0, 1, 2,…, 4999 consecutively to these nodes. Now let each node i choose *six* short distance neighbors (i+1) mod n, (i+2) mod n, (i+3) mod n, (i-1) mod n, (i-2) mod n, (i-3) mod n. Compute (i) the average clustering coefficient and (ii) the diameter of this network, and report these values. Use the built-in functions of NetworkX as far as possible.

Part 2 (60 points): Now "rewire" this topology by allowing each node i to replace its neighbor (i+1) mod n by a long distance neighbor with a

probability p. Compute (i) the average clustering coefficient and (ii) the diameter of the network generated by rewiring. Repeat this experiment for various values of p starting from 0.00 and incrementing it in steps of 0.01 until the diameter decreases "substantially", i.e. almost levels off to a smaller value. Plot the **clustering coefficient vs. p** and **diameter vs. p** graphs. (To refresh your memory, see the corresponding graphs in the original paper.)

Part 3 (10 points): From the above plots, identify for what value of p will you consider the topology to be a small-world topology. Justify your decision.

[1] Duncan J. Watts & Steven H. Strogatz: Collective dynamics of 'small-world' networks. Nature 393, 440-442 (4 June 1998) (Cited by 27266)