

22C: 196: 003 Peer-to-peer and Social Networks

Homework 1

100 points

Assigned 2/7/13 due 2/14/13

Download NetworkX, a Python package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks. It will simplify your effort in solving the homework problems. This package has a library of various kinds of graphs as well as the implementation of various useful algorithms for social network analysis. You have to submit one zip file containing (1) a readme file describing your strategy for solving the problem (2) the codes, and (3) the output or the results as appropriate.

Question 1 (50 points): The goal of this homework is to generate a social network using the idea of *preferential attachment*. Recall how such a graph is generated. Starting with a single node, in each step, add a node to the network using *a single* edge. The probability of choosing the node to which it will attach will be proportional to the degree of that node.

(a) Using this rule, generate three graphs $n = 1000, 2000, 5000$ nodes.

(b) Show the degree distribution of the generated graph. For this, plot $\log N(k)$ vs. $\log k$, where k is the degree of a node, and $N(k)$ is the number of nodes having degree k . Verify that the power law ($N(k) = c k^{-r}$) holds, and estimate the value of r .

Question 2 (50 points): Consider the *Karate Club* network discussed in the class (and also check the major sources, like Kleinberg's book or Girvan and Newman's paper). Your tasks are as follows:

(a) Compute the edge(s) of highest betweenness in this network.

(b) Remove the edge(s) of highest betweenness, and visualize the graph and see if it has been partitioned into disjoint communities. If not, then repeat the above two steps, until the graph partitions and then stop.

(c) List the edges that you removed.