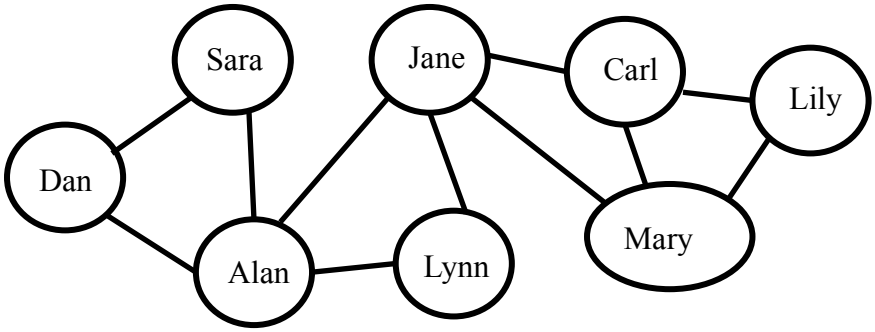
Introduction to Complexity

Unit 9 Homework

Beginner Level:

For Questions 1 – 3, use the following social network:



1. Draw the degree distribution for this network.

2. How long is the shortest path between Dan and Lily?

3. What is the clustering coefficient of this network?

4. Choose a well-known person (that you don't personally know). Find a path to that person in your social network where you can only count hops between people who know each other well (similar to Melanie's path to Barack Obama, described in the lecture). How many hops are there? Now see if you can find a shorter path. Feel free to share any interesting findings on the Course Forum!

5. Draw a degree distribution for a small part of your Facebook social network (or any other social network you choose), using your friends and friends of your friends. (You just need to know the number of links coming from each node.) Does the degree distribution have a power-law-like shape?

6. Download **SmallWorldNetworks.nlogo** from the Supplementary Materials page. Experiment with this model: Set *node-count* to 200 and *neighbor-count* to 4. How do the average path length and network clustering coefficient change when you rewire 2% of the nodes (*beta* = 0.02)? How about 5% of the nodes (*beta* = 0.05)? How about 10%? How about 50%? Are the results what you would expect?

Intermediate level:

Add an option to **preferential-attachment.nlogo** that allows the user to build a random network — that is, instead of biased probability of selecting which existing node to link to, a new node chooses an existing node with uniform probability. When you build a

random network, how does the degree distribution shape compare with that of a scale-free network?

Advanced level:

The NetLogo model **preferential-attachment.nlogo** works by adding one node at a time and choosing an existing node for it to link to. An alternative (perhaps more realistic) process would be to add several nodes at a time, each choosing existing nodes to link to. Modify **preferential-attachment.nlogo** to allow the user to set the number of nodes to add at each iteration. Does changing this number still result in basically the same power-law degree distribution?