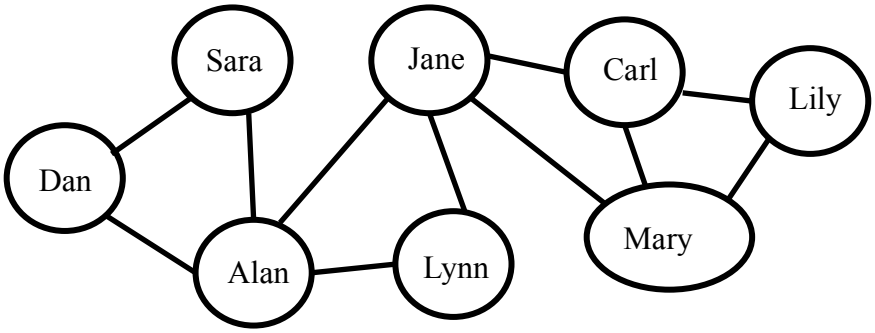
Introduction to Complexity

Unit 1 Homework

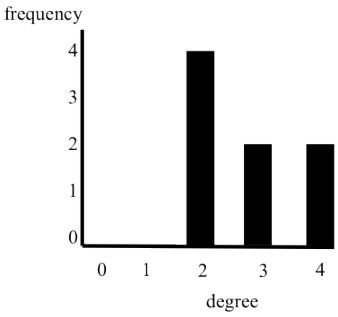
Note: The models SmallWorldNetworks.nlogo and PreferentialAttachment.nlogo are downloadable from the Course Materials page.

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

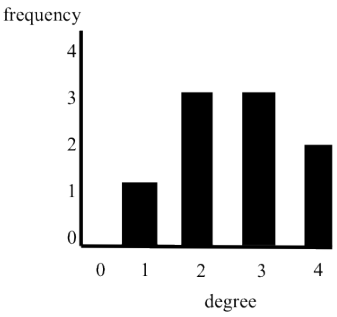


1. Which of the following is the correct degree distribution for this network?

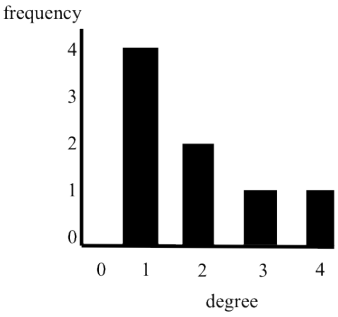
A.



B.



C



2. What is the clustering coefficient of this network? [Hint: Find the clustering with respect to each of the 8 nodes, and then take the average.]

A. 0.5

B. 0.67

C. 0.75

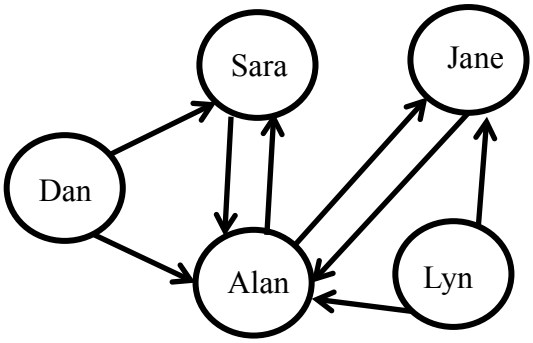
3. How long is the shortest path between Dan and Lily?

A. 3 hops

B. 4 hops

C. 5 hops

Questions 4 and 5 refer to this directed network:



4. What is Alan's in-degree?

A. 2

B. 3

C. 4

D. 5

5. What is Alan's out-degree?

A. 2

B. 3

C. 4

D. 5

6. Download small-world.nlogo from the Course Materials page and open it. Set *node-count* to 200, *neighbor-count* to 4, and *beta* to 0, and click **setup**. Record **global-average-distance**. Now change *beta* to 0.05, click setup, and record **global-average-distance.** Do the same for *beta* set to 0.1, 0.2, and 0.3.

Which change in beta yields the largest decrease in **global-average-distance**?

(E.g., suppose *beta* = 0.2 gave global-average distance = 3.8, and *beta* = 0.3 gave global-average-distance = 3.6. Then the change from *beta* = 0.2 to *beta* = 0.3 would yield decrease 3.8 − 3.6 = 0.2.)

A. The change from *beta* = 0 to *beta* = 0.05 yields largest decrease.

B. The change from *beta* = 0.05 to *beta* = 0.1 yields largest decrease.

C. The change from *beta* = 0.1 to *beta* = 0.2 yields largest decrease.

D. The change from *beta* = 0.2 to *beta* = 0.3 yields largest decrease.

E. All the decreases were equal.

7. Compare the value of **global-average-distance** when *beta* is 0.05 (5% of the links rewired) to when *beta* is 1.00 (all of the links are rewired), both with node count at 200 and neighbor count at 4. By what factor does global-average-distance change? (I.e., what is (**global average distance** for *beta* = 0.05) divided by (**global average distance** for *beta* = 1.00?)

Choose the answer closest to what you obtained.

A. About 50

B. About 12

C. About 1.5

Optional ungraded homework

Beginner:

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).

Draw a degree distribution for 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?

Intermediate/Advanced:

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?