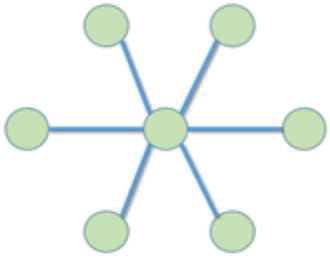
SI 301
Assignment 2
Due in class on Tue September 19th

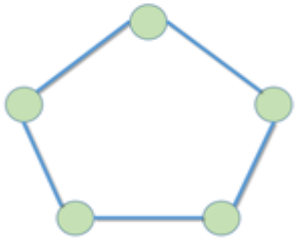
Reading: Sections 3.1 – 3.5 of textbook.

1. Problems 2,3,4 and 5 in section 3.7 of textbook.
2. Give an example of a connected network with at least three nodes such that:
    a. Every edge is a bridge.
    b. Every edge is a local bridge, but no edge is a bridge.
3. Add new edges to each of the following graphs such that the resulting graph has as many *local bridges* as possible. After the edges have been added, label all local bridges in the graph. If it's not possible to create new local bridges by adding edges, explain why. Note that you are not allowed to remove any existing nodes or edges.

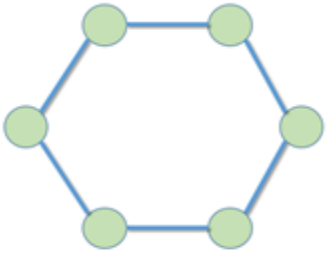
(a)



(b)



(c)



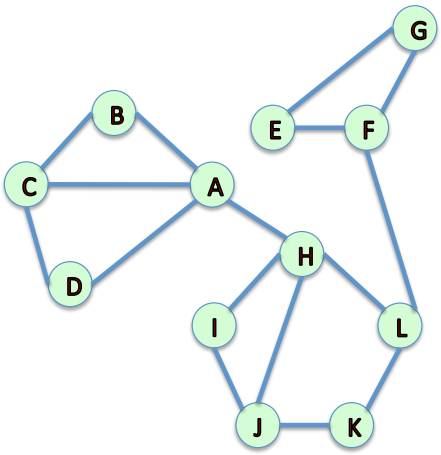
(d)

4. In class, we proved a claim that shows that under two conditions, local bridges are always weak. In this exercise, you will see that both conditions are necessary for the claim to hold by coming up with examples of networks that contain strong local bridges and satisfy only one of the two conditions.
Give an example of a connected network with at least 4 nodes, where edges are labeled as weak (W) or strong (S), that contains a strong local bridge A—B and:

a. Node A has at least two strong ties.
b. Node A satisfies the Strong Triadic Closure.

Note that the properties from part (a) and part (b) cannot be satisfied simultaneously.

5. Consider the network shown:
   a. Compute the local clustering coefficient of each node.
   b. Find all bridges.
   c. Find all local bridges and their span.
   d. How many components would the network have if we removed all bridges from the network?



6. Researchers are curious about how external events may affect a social network's structure and communicative properties. They carry out a study using an instant-messaging (IM) communication data set collected from a hedge fund. The data contains even IM exchanged in the hedge fund including a timestamp, sender, receiver, and the content of the IM. For each stock s and each day d, an undirected graph $G_{s,d}$ is defined as follows: each node represents a trader in the hedge fund. There is an edge between two nodes if the two traders have an IM exchange about stock s on day d.
   a. If we were interested in measuring the strength of edges in the graph $G_{s,d}$, how would you measure it using the IM data? Justify your answer.
   b. Now think about price changes of the stock s. Some price changes are disruptive and unexpected – they are greater than recent changes -- which may come as a shock to the nodes in network $G_{s,d}$. Do you think traders prefer to communicate with their strong or weak ties during a shock? Explain.
   c. During a shock, do you think traders prefer to talk to others with whom they share many or few connections? Explain.
   d. Based on your answer to (c), how would you expect the Mean Local Clustering Coefficient (MLCC) of $G_{s,d}$ to change on a day d when a shock occurs, compared to the MLCC of $G_{s,d'}$ on a day d' when a shock did not occur? Justify your answer.