Math 168, Networks, UCLA, Spring 2018
Problem Sheet 6

(submit to CCLE by Monday 14 May 2018 at 5:00 pm)

1. *Reading.* Read Chapters 12 and 13 of Newman's book.
2. Do Problem 7.1 of Newman's book.
3. Do Problem 7.4 of Newman's book.
4. Do Problem 7.5 of Newman's book.
5. Do Problem 7.8 of Newman's book.
6. *More on centralities.*
   (a) Use a data set for a small unweighted, undirected network. Using numerical computations, calculate some version of betweenness centrality, closeness centrality, and eigenvector centrality for all of the nodes in this network. (You are also welcome to calculate other centrality measures if you wish.) The solution that you submit should include one plot for each centrality measure (the plot should convey the centrality of each node in some way), and a statement of the network that you used along with a proper reference for it. Also indicate the number of nodes and edges in the largest connected component of this network, as well as the specific definitions of the centrality measures that you used. Are you able to make any observations from your calculations?
   (b) Fix the number of nodes (N) in an unweighted, undirected network without self-edges or multi-edges. What structure should this network have to include a node that achieves the theoretical maximum value of geodesic node betweenness centrality?
   (c) Write down a seemingly reasonable version of geodesic node betweenness centrality for weighted networks. Does it have any flaws?
   (d) Comment on the robustness (or lack thereof) of centrality measures such as betweenness. Do an example set of calculations to explore the robustness of a centrality measure. Whatever you calculated is a robustness with respect to *something*. Indicate what this something is.
7. *Dynamical importance.* Derive the equations for node and edge dynamical importance that I discussed in lectures. What assumptions do you need to make for these derivations?