1. [Power Network]  
Download the power grid network from [http://konect.uni-koblenz.de/networks/opsahl-powergrid](http://konect.uni-koblenz.de/networks/opsahl-powergrid).

   (a) Compute the maximum bottleneck flow among all pairs of nodes. (This may be easier than it seems.)

   (b) Revisit various measures of the maximum flow among pairs of nodes from the previous homework, and make comparisons to bottleneck flow.

2. [Network Coding]  
Consider the example given in Figure 7 of the paper, “Network Information Flow” by Rudolf Ahlswede, Ning Cai, Shuo-Yen Robert Li, and Raymond W. Yeung that appeared in the IEEE Transactions on Information Theory in 2000.

   (a) Try to analyze the limitations on flow in this setting using the techniques of multicommodity flow that we developed in lecture.

   (b) Work through the network coding idea that is presented therein and argue why the max-flow / min-cut theorem is applicable for that example.

3. [Creativity]  
Propose an engineering problem that can be addressed using the citation network among US Patents data that is available from [https://snap.stanford.edu/data/](https://snap.stanford.edu/data/). Your solution should essentially be a description in words and figures.

4. [Eigenvalue Centrality]  
Please complete Problem 7.1 in Newman’s textbook.

5. [PageRank Centrality]  
Please complete Problem 7.2 in Newman’s textbook.

6. [Closeness Centrality]  
Please complete Problem 7.3 in Newman’s textbook.

7. [Betweenness Centrality]  
Please complete Problem 7.4 in Newman’s textbook.

8. [Creativity for a Centrality Measure]  
Please put forth a novel notion of node centrality that might arise in some real application and then define a mathematical centrality measure that captures this notion.