Please do your homework using an R script. Homework is NOT collected in this class. However, on the day it is due, you may be asked to share your screen and run some of your code when we discuss this homework in class. This will count towards your participation grade.

1. Use the lazega network, downloaded from Moodle.  
   1. This network is not connected, but it has a giant component. Create a new network consisting of the vertices in the giant component. Then plot it.
   2. Which vertex has the highest degree? What percentage of the vertices in the network are connected to this vertex?
   3. Plot the network again; using plot arguments only, color the vertices “wheat”, except the three vertices with the highest degree centrality, color those red.
   4. Find the three vertices in the network with the highest closeness centrality. What is their normalized closeness centrality? Plot the network again, giving everyone a circle shape except these three; give them a square shape.
   5. Find the three vertices in the network with the highest betweenness centrality. What is their normalized betweenness centrality? Plot the network again, giving everyone a black vertex frame color except these three; give them a blue vertex frame color.
   6. Find the three vertices in the network with the highest eigenvector centrality. Plot the network again, giving everyone a black vertex label color except these three; give them a green vertex label color.
   7. Find the three edges with the highest edge centrality. If we select 2 vertices from this network and a shortest path between them, what is the probability that the edge with the highest edge centrality lies on this shortest path? Plot the graph again, coloring all edges black, except these three; color those pink. Why do you think those edges have the highest edge centrality when they do not look to be central?
   8. What is the transitivity of the network? What does this mean? Also find the local transitivities. Two vertices have a transitivity equal to 1; which vertices? Create egocentric networks of order 1 for each of them and inspect by plotting them. Do you see why their transitivity is 1?
   9. Is the network assortative by the office the partners work at? If so, explain. Also find the assortativity coefficient of the degree, and explain its value.
2. Use the UKfaculty network from igraphdata, access it with data(UKfaculty).  
   1. This directed network is not strongly connected, but it has a strong giant component. Create a new network consisting of the vertices in the giant component. Then set the vertex names to their indices. Use this giant component for the remaining questions.
   2. Find the three vertices with the highest in-degree.
   3. Find the three vertices with the highest closeness centrality. Explain what this means.
   4. Find the three vertices with the highest PageRank. Explain what this means.
   5. Find the three main hubs. What Group are they in?
   6. Find the three main authorities. What Group are they in?
   7. Change the network so that the color of the vertices is set to the Group number (Group is a vertex attribute). Plot the graph changing both the vertex size and the arrow size to something small. Use the Kamada-Kawai layout, and the rainbow(4) palette. Also include a legend explaining the colors of the groups.
   8. Plot the network again, letting the size of the vertices be determined by their hub score.
   9. Plot the network again, letting the size of the vertices be determined by their authority score.
   10. Show both the dyad census and the triad census for this network. The sixth value of the triad census is 531; what does this mean?
   11. What is the reciprocity of the network? What does this mean? Also give its ratio reciprocity.