HOMEWORK 1

Please submit your homework to xm@bu.edu. Don't forget to attach your figures and code. Feel free to ask me if you have any question. GLHF!   -Sean.

Problem 1: examples of real networks

1. List three different networks in real world and write down the nodes and links of them.

2. Choose one that you are personally most interested in. How large do you estimate the network is? Why are you interested in it?

3. Try to find the data you need from the Internet (or write down a plan that is achievable). Data hunting is often a big challenge for scientists!

Problem 2: matrix formalism

Let **A** be the adjacency matrix of an undirected unweighted network without self-loops, of size N. Define **1** as a vector of N elements which are all equal to 1. In terms of only these two quantities and by using matrix operations such as *matrix multiplication*, *transpose*, *trace*, etc., write expressions for:

1. Vector **k** whose elements are the degrees k_i of nodes $i = 1, 2, \cdots, N$;

2. Total number of links N_l in the network;

3. Matrix **M** whose element M_{ij} is equal to the number of common neighbors of nodes i and j.

4. Total number of triangles N_{tri} in the network. A triangle means three vertices each connected by edges to both of the others. (Hint: use the trace of matrix.)

Note: the sum symbol $\sum$ is not necessary and not allowed.