

# PHYS 597A: Graphs and networks in systems biology

## Homework assignment 1, due Thursday Sept. 3

1. Find an example for a network in your research area or everyday life. Define the nodes and edges and give/estimate their numbers. Are the edges directed or not? If it is not too large, draw the network.

Characterize the network using the graph concepts learned in class. For example (but don't restrict yourself to these!), is it connected (if the edges are undirected) strongly or weakly connected (if the edges are directed), what is the average, maximum and minimum node degree, what is the maximum distance between two nodes, are there any circuits or completely connected subgraphs in the network? Which of these graph measures are most informative for your chosen network?

2. Start with 10 isolated nodes.

(a) For each pair of nodes, throw with a die, and connect them if the number on the die is 1. Describe the graph you obtained. Is it connected or not? What is the average degree and the degree distribution? Are there any cycles?

(b) Now connect node pairs if the number is 1 or 2. How is the graph different from the previous case?

(c) How many edges do you expect a graph with  $N$  nodes will have if they are accepted by throwing with a die (in other words, they are accepted with probability  $p = 1/6$ )?

(d) Extra credit question: for the graph in point c, what is your expectation for the shape of the curve determined by the degree distribution when  $N$  is large? E.g. will it be decreasing, increasing, have a peak, have a valley?