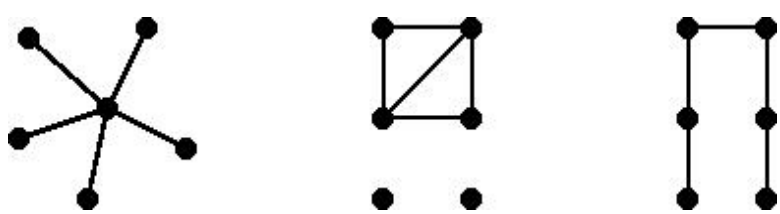
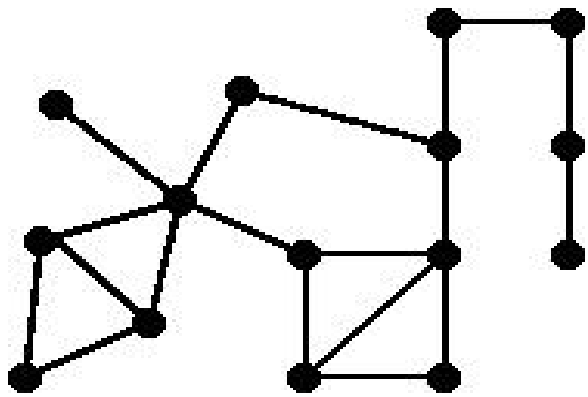
Probabilistic Models, Homework 3, due February 14

Turn-in problems:

1. Consider the yeast network which has $N = 6,018$ and $\alpha = 0.0087$, and let $K = 10$. Compute the speciation probability in our model and in Orr's model, and compare the two if $p = 0.1$. Comment on qualitative and quantitative aspects of "snowballing."

2. For each of the three networks below, let X be the number of interactions (edges) when we choose $K = 3$ nodes. Note that all networks have $N = 6$ and $N_E = 5$.

(a) For each network, find $P(X = j), j = 0, 1, 2, 3$ (easier to use brute force than trying sophisticated combinatorics).
(b) For each network, compute $E[X]$ both using **(a)** and the expression $\alpha\binom{K}{2}$ (and make sure they coincide).
(c) For each network, compute the speciation probability $E[S]$ for $p = 0.1$, both exactly using **(a)** and with our approximation formula.
(d) For each network, compute the variance $\mathrm{Var}[X]$ using **(a)**.
(e) In **(c)**, find the difference (without sign) between the exact and approximate answers and plot them against the variances in **(d)**. Comment!



3. For the network below, find N, N_E, N_S, and N_D.