

HOMEWORK 4

Problem 1: Friendship paradox

Assume the network in this problem is a scale-free network which has a power-law degree distribution $p_k \sim k^{-\gamma}$, with N nodes, minimal degree k_{\min} and maximal degree k_{\max} .

1. What is the normalization factor of p_k ?
2. What is the average degree $\langle k \rangle$? What is the total number of links L ?
3. How many links are there which are connected to a node that has degree k ? (Hint: the probability of two nodes with the same degree being connected is comparably small.)
4. What is the probability that a randomly chosen node has a neighbor with degree k ?
5. What is the average degree of the neighbors of a randomly chosen node? Compare your answer to $\langle k \rangle$. How can you explain the difference?
6. Randomly choose ten friends from your Facebook friend list and see how many friends they have. Try to estimate γ of the Facebook friend network. (Assume $k_{\min} = 1$ and $k_{\max} = \infty$.)

Problem 2: Network visualization

Generate three scale-free networks with $k_{\min} = 1, 2, 3$ separately and visualize them each using a different graph layout method. Suppose $\gamma = 2.5$ and $N = 300$.

-Sean.