CPSC 619-600: Computer Networks
Homework 4 due March 30, 2017

1 Purpose

This homework studies random graphs $G(n,p)$ and emergence of connectivity in these structures. Note that log refers to the natural logarithm.

2 Description

2.1 Construction

Assume n and p are given. Suppose $M = \text{Binomial}(n(n-1)/2, p)$ is the random number of edges in $G(n,p)$. Create an algorithm that constructs $G(n,p)$ using no more than M calls to the random-number generator. Make sure to store the graph in RAM using adjacency lists rather than a full matrix.

2.2 Connectivity

Fix $n = 100\text{M}$. Plot the probability q the graph is connected using $p = c\log(n)/n$, where c sweeps the interval $[0.5, 1.5]$ in small increments. At what value of c does q shift from 0 to 1?

2.3 Clustering

Design an efficient algorithm for computing the clustering coefficient. Then, use $p = 3\log(n)/n$ and plot the clustering coefficient $\gamma(G)$ for n between 100 and 10M, going in increments of $10\times$ (also, use a semilogx plot). Speculate what happens to $\gamma(G)$ as $n \to \infty$.

2.4 Diameter

Plot the diameter D of $G(n,p)$ for $p = 3\log(n)/n$ as a function of n. Using a curve-fit, estimate how D depends on n.