Complex Network-Homework Assignment

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Notice

1. Submit your results as a PDF file for each of them.
2. The deadlines are Sep. 26 (HW1), Oct. 3 (HW2), Oct. 10 (HW3), 15： 15.
3. Violating the deadline results in a punishment on your corresponding score.
4. The expected local clustering coefficient for a node that has exactly 5 neighbors

Outline

HomeWork 1

Observation

Consider a random network generated according to the G(N, p) model where the total number of nodes is 12 and the probability that there are links between any two nodes is 0.20. Determine the following:

Questions

1. The probability that there are exactly 60 links in the network.
2. The average number of links in the network. networks are useful for getting insight in their structure
3. The average node degree
4. The average path length (distance between any two nodes in the network)
5. The average local clustering coefficient for any node in the network.
6. The expected local clustering coefficient for a node that has exactly 5 neighbors

Outline

Degree Distribution for Preferential Attachment

$G_0 \in \mathrm{ER}(n_0, p)$ with $V_0 = G_0$. At each step $t > 0$:

1. Add a new vertex $v_s : V_s \leftarrow V_{s-1} \cap v_s$.

2 Add $m < n_0$ edges incident to V_s and a vertex u from V_{s-1} (and u not chosen before in current step). Choose u with probability

$$\mathbb{P}[\text{select } u] = \frac{\delta(v)}{\sum_{w \in V_{s-1}} \delta(w)} \tag{1}$$

Note: choose u proportional to its current degree.

3 Stop when n vertices have been added, otherwise repeat the previous two steps.

This process will lead to a Barabasi-Albert graph, $\mathrm{BA}(n, n_0, m)$.

The degree distribution for a BA graph is
For any $\mathrm{BA}(n, n_0, m)$ graph G and $u \in V(G)$:

$$\mathbb{P}[\delta(u) = k] = \frac{2m(m+1)}{k(k+1)(k+2)}. \tag{2}$$

Prove this result

Outline

Homework 3

Read the materials of shrinking diameter and try to prove it by yourself.