HalProg beadandó

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1 Erdős-Rényi model

Parameters: N (number of nodes), p (linking probability).
Building mechanism: The N nodes are given, each node-pair is linked with probability p.
Quantities:

- $<k>$ (average degree) $\sim$ Np
- $<l>$ (average shortest path) $\sim \frac{lnN}{ln<k>}$
- $p(k)$ (degree distribution) $\sim \binom{N}{k} p^k (1-p)^{(N-k)} \sim \frac{<k>^k}{k!} e^{-<k>}$
- M (expected number of links) $\sim \frac{pN(N-1)}{2}$
- $<c>$ (average clustering coefficient) $\sim p$

2 Watts-Strogatz model

Parameters: N (number of nodes), q (positive integer), β (rewiring probability).
Building mechanism: Form a ring from the given N nodes, then for each node link it to its first q neighbours. Then, rewire each link with probability β to a random node (graph must remain simple).
Quantities:

- if $\beta = 0$:
  - $<l> \sim \frac{N}{4q}$
  - $<c> \sim \frac{3q-3}{4q-2}$
- if $\beta = 1$:
  - $<l> \sim \frac{lnN}{ln2q}$
  - $<c> \sim \frac{2q}{N-1}$

3 Barabási-Albert model

Parameters: t (number of timesteps), m (initial link number of the arriving node).

Or, if we have a small core relative to the t parameter then the number of nodes N is almost the same as t. So we can use N as parameter instead of t.
Building mechanism: There is a core with at least m nodes. In each timestep a node is introduced to the system with m link to the previously presented nodes. The probability of linking is proportional to the degree of the nodes: $P(k_i) = \frac{k_i}{\sum\limits_j k_j}$. Trivially, $N \sim t$ and $M \sim mt$ on the long run.

Quantities:

- $k_i(t)$ (degree of a node i over time) $\sim m\left(\frac{t}{t_i}\right)^{0.5}$
- $p(k) \sim 2m^2 k^{-3}$
- $<c> \sim \frac{m(lnN)^2}{8N}$

4 Source material

- Complex network analysis course lecture notes (http://pallag.web.elte.hu/networks/). The first 7 slides contain these models and a couple of calculations)
- Wikipedia

5 Megjegyzések

Egyik modelhez sem írtam oda, mi a jelentősége, vagy mik a hátrányai, ha valós hálózatokat szerenténk modellezni. Továbbá mind a W-S mind a B-A modelnek van(nak) hangolható változata(i), amiket nem tárgyalok.