Modeling Dynamics of Information Networks

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”Networks may be viewed as the natural embedding of a world with a limited information horizon”
Why complex networks?

- Who is connected to whom?
  - Indistinguishable nodes — inessential question.
  - Unique nodes — fundamental question.
Perfect centralized network

- Everybody close to each other
- Links are expensive

Imperfect information
Limited information horizon

Agent $i$ has a memory that gives rise to a rough picture of the network

$$M_i = \begin{cases} \ D_i(l), & l = 1, 2, \ldots, i - 1, i + 1, \ldots n, \\ P_i(l) \end{cases}$$

The distance $D_i(l)$ is agent $i$’s estimated shortest path length to agent $l$.

The pointer $P_i(l)$ is agent $i$’s nearest neighbor on the estimated shortest path to agent $l$.
Rewiring

- An agent $i$ and one of its neighbors $j$ are chosen at random.
- An agent $l \neq i, j$ is randomly chosen and if $D_i(l) > D_j(l)$ the link between $i$ and $j$ is rewired to a link between $i$ and $k$.
- Update of information if rewiring was successful.
Degree distribution

\[ P(C') \sim C^{-2} \]
Overall correctness of information can be modeled by *information exchange* and *average degree*.

Self-organization: Create links with probability $P_c = 1 - C_2/C_1$, remove links with probability $1 - P_c$.
Information $I_{\text{about}}$ is defined as the fraction of other agents that have correct information about their distance and direction to an agent.

Information $I_{\text{of}}$ is defined as the fraction of correct information an agent has about distances and directions to all other agents.
Test for correlations between vertices with different degrees by comparing with a randomized version of the network. — Hierarchy!