

“Networks may be viewed as the natural embedding of a world with a limited information horizon”

# Modeling Dynamics of Information Networks

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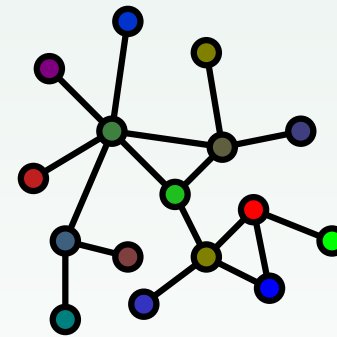
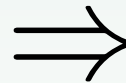
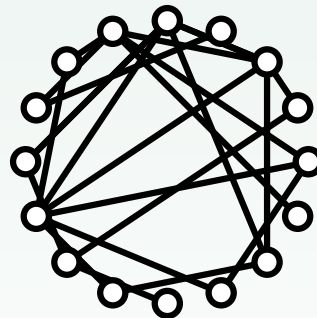
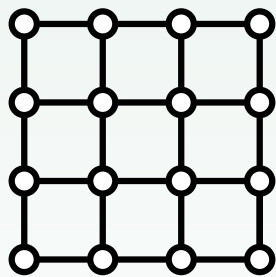
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# Why complex networks?

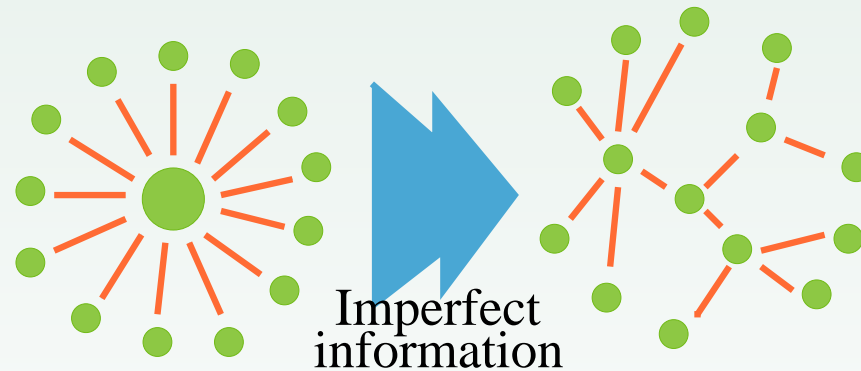
–Who is connected to whom?

- Indistinguishable nodes — inessential question.
- Unique nodes — fundamental question.



# Perfect centralized network

- Everybody close to each other
- Links are expensive



# Limited information horizon

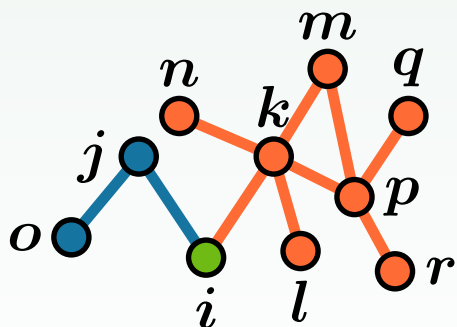
Agent  $i$  has a memory that gives rise to a rough picture of the network

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

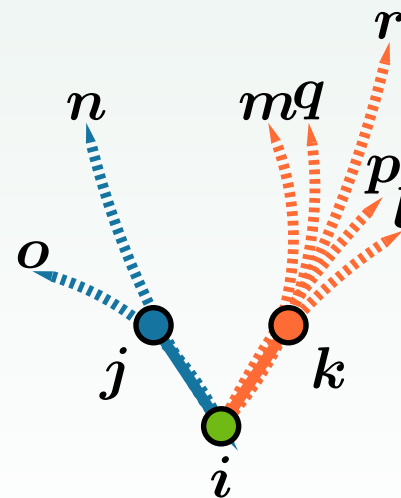
The distance  $D_i(l)$  is agent  $i$ 's estimated shortest path length to agent  $l$ .

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

Global perspective

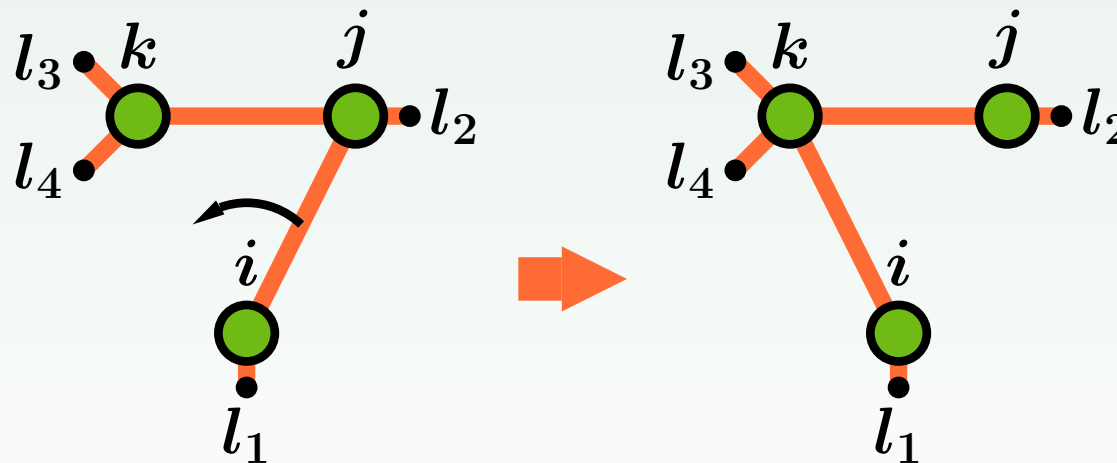


Agent perspective

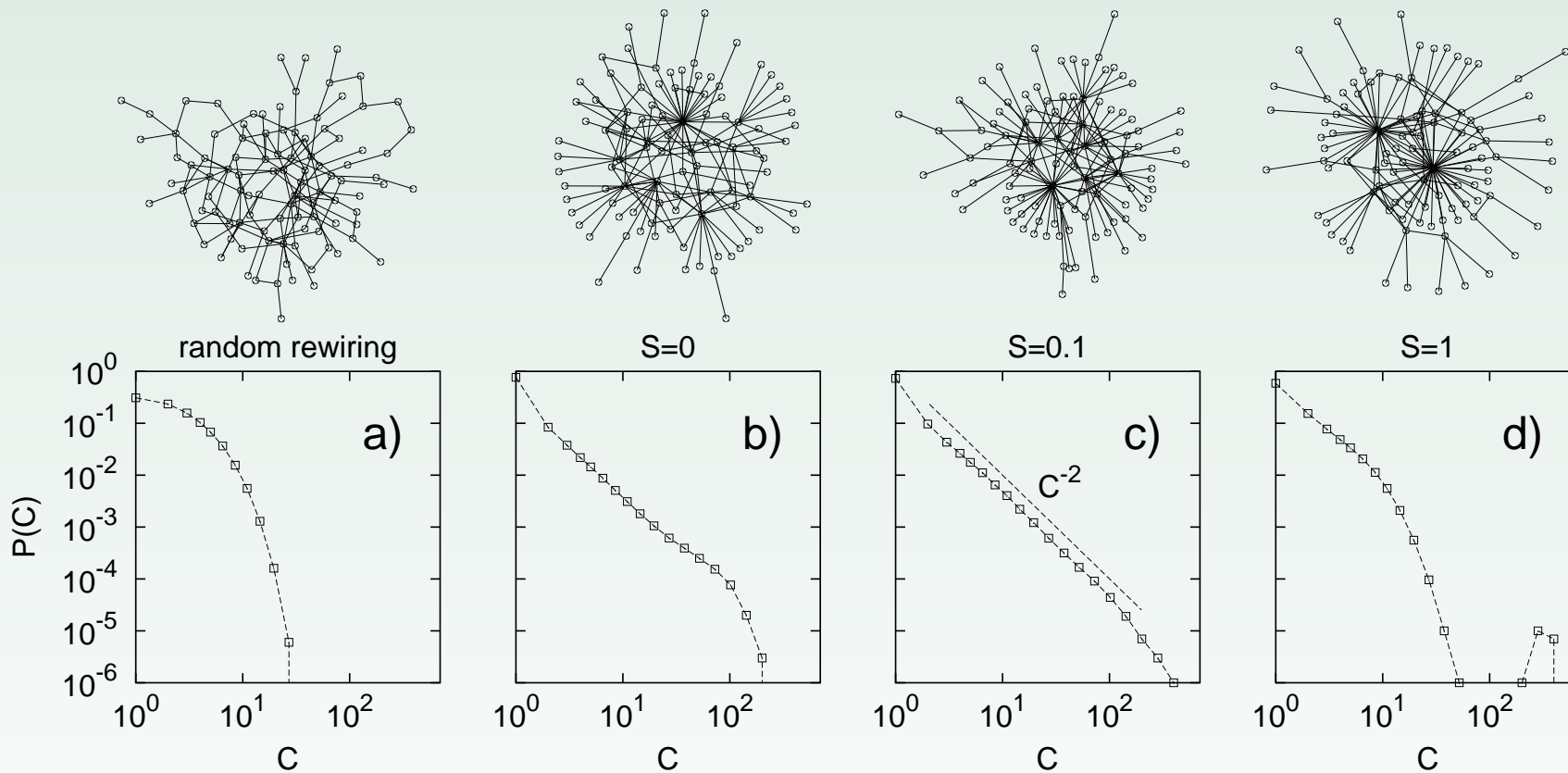


# Rewiring

- 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.

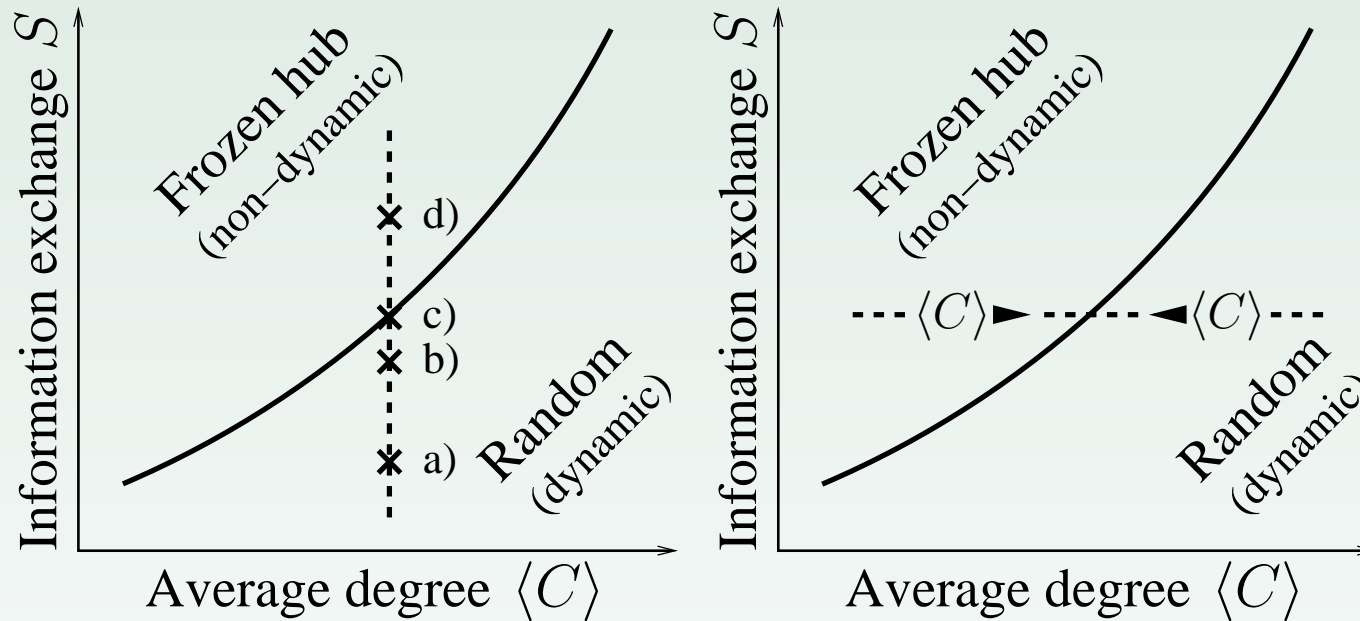


# Degree distribution



$$P(C) \sim C^{-2}$$

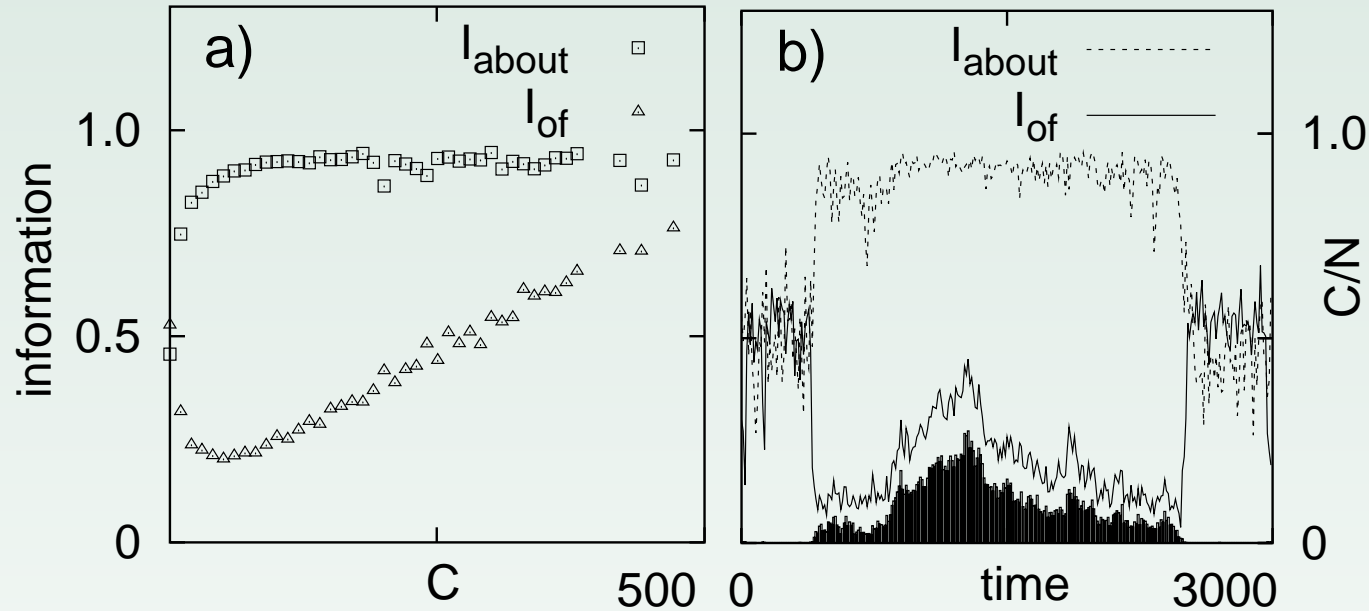
# Critical information exchange



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  $1 - P_c$

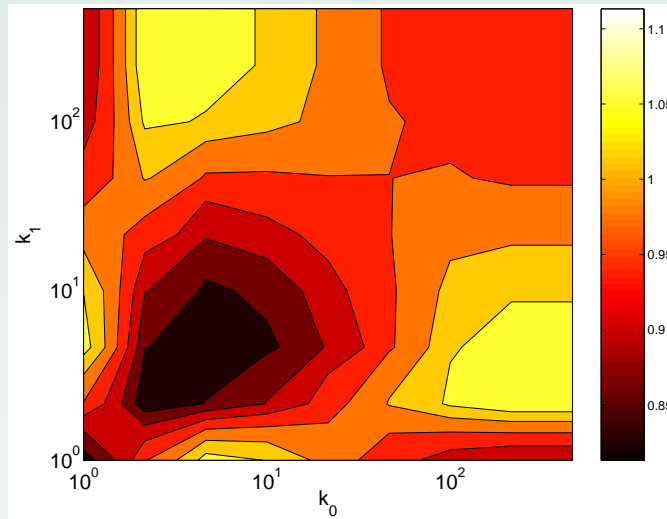
# Information



Information  $I_{about}$  is defined as the fraction of other agents that have correct information about their distance and direction to an agent.

Information  $I_{of}$  is defined as the fraction of correct information an agent has about distances and directions to all other agents.

# Correlation profile



Test for correlations between vertices with different degrees by comparing with a randomized version of the network. — Hierarchy!