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Low Transparence Networks

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*Tehran school on Theory and Applications of
Complex Networks*

25-29 August 2018



- The first step to study a network we should have a network.
- In some cases, your understanding about a network is different from mine.
- It seems nature would like to hide some information.
- Its ways: noise, keeping the information and creating fake information.



360° Wide Angle
Camera



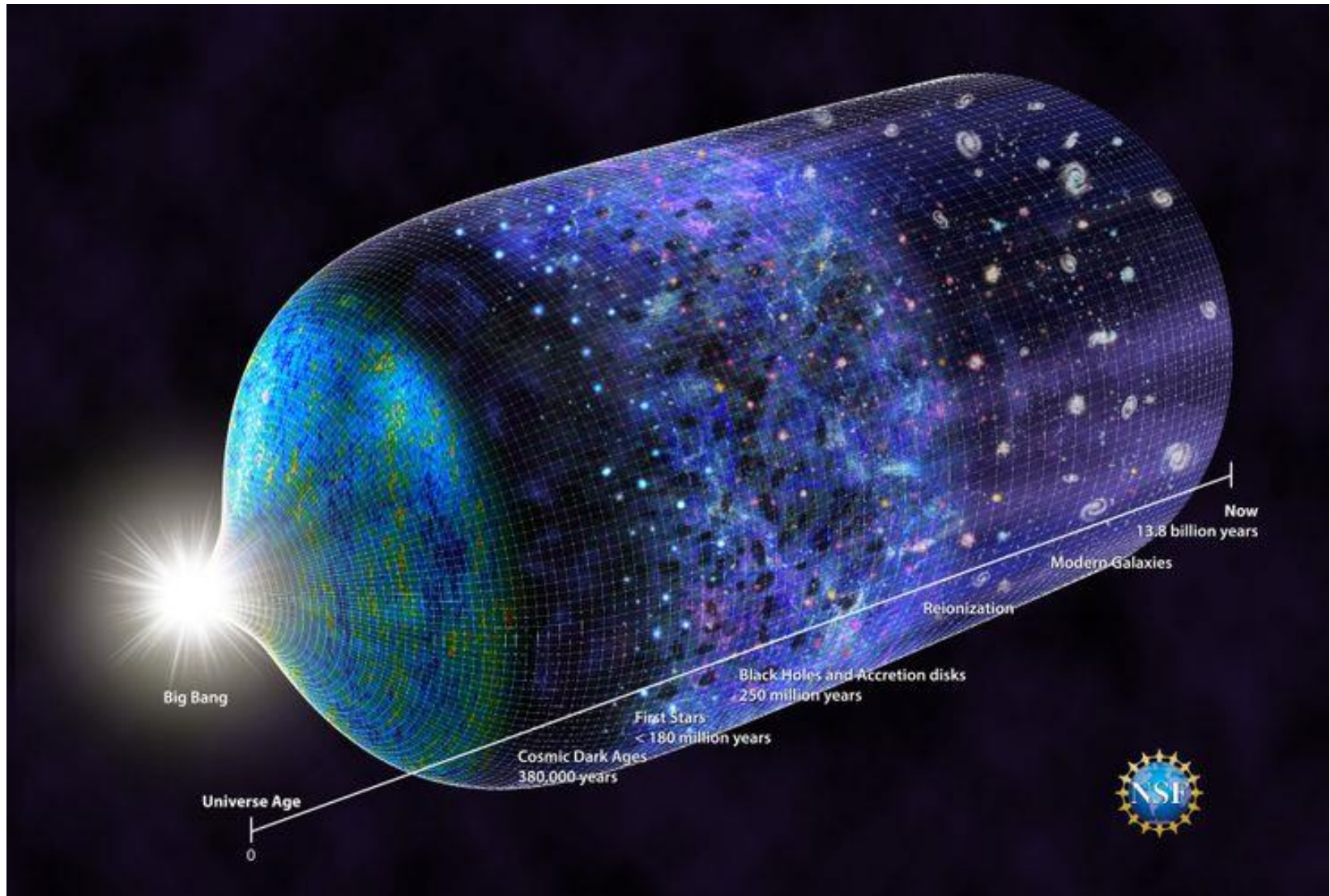
Fisheye 360°



Dark Networks



Universe



Networks & Puzzles



Sophia - Alexa



Sophia is a social humanoid robot developed by Hong Kong-based company Hanson Robotics April 2015.



Amazon smart robot November 2017 might be able in “as early as 2019.”

Everyday we create more than 10 quadrillion bytes (10^{18} Bytes), which more than 60% has been created in the recent two years.

How dose **dictatorship** emerge from **censorship**?

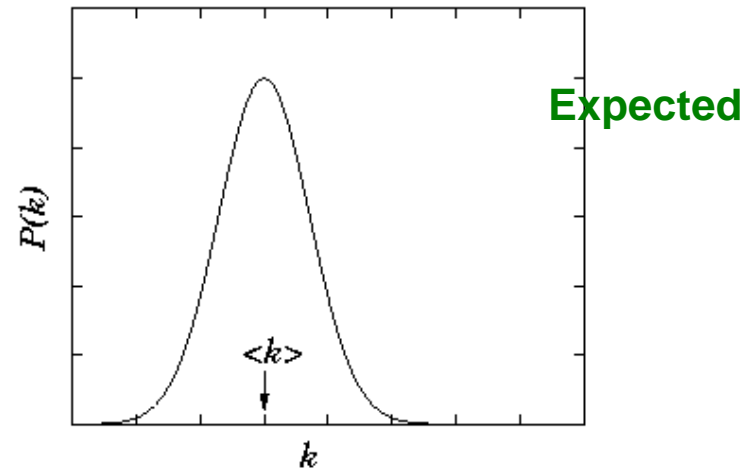
World Wide Web

Nodes: WWW documents

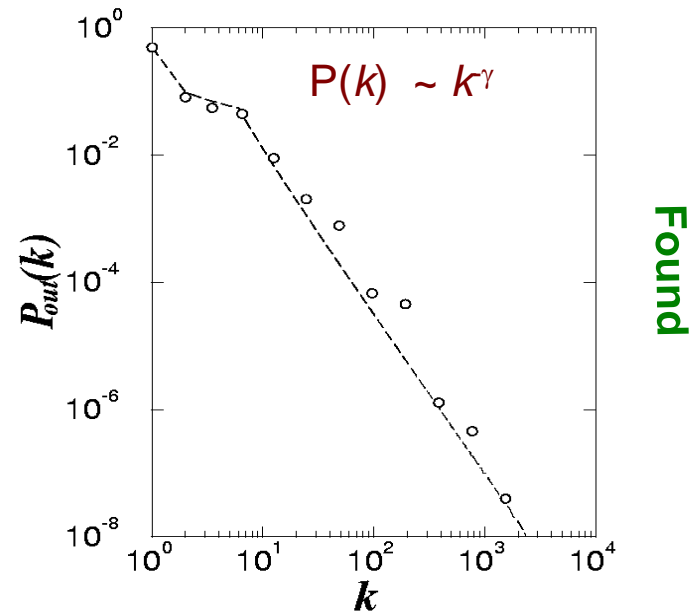
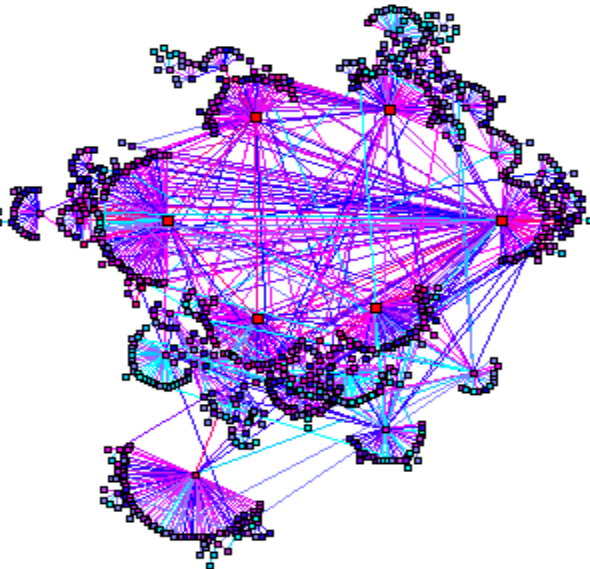
Links: URL links

Over 3 billion documents

ROBOT: collects all URL's found in a document and follows them recursively



Scale-free Network



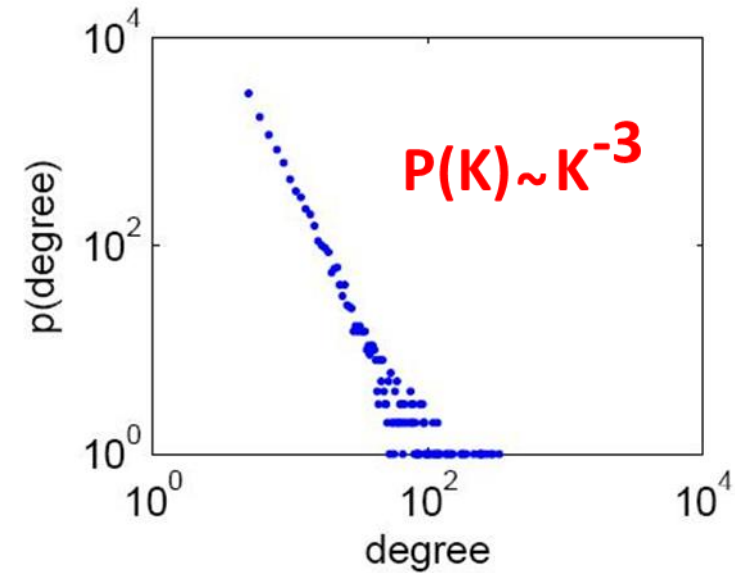
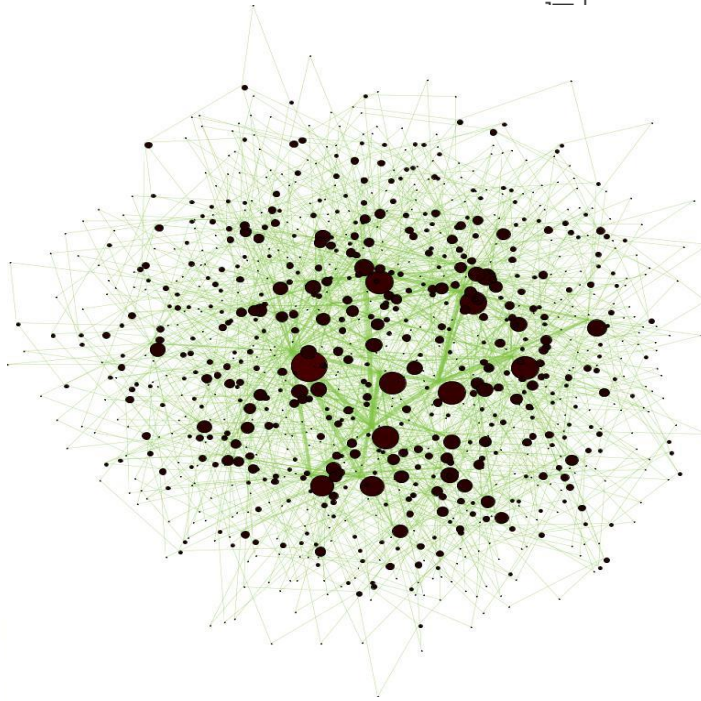
Preferential Attachment



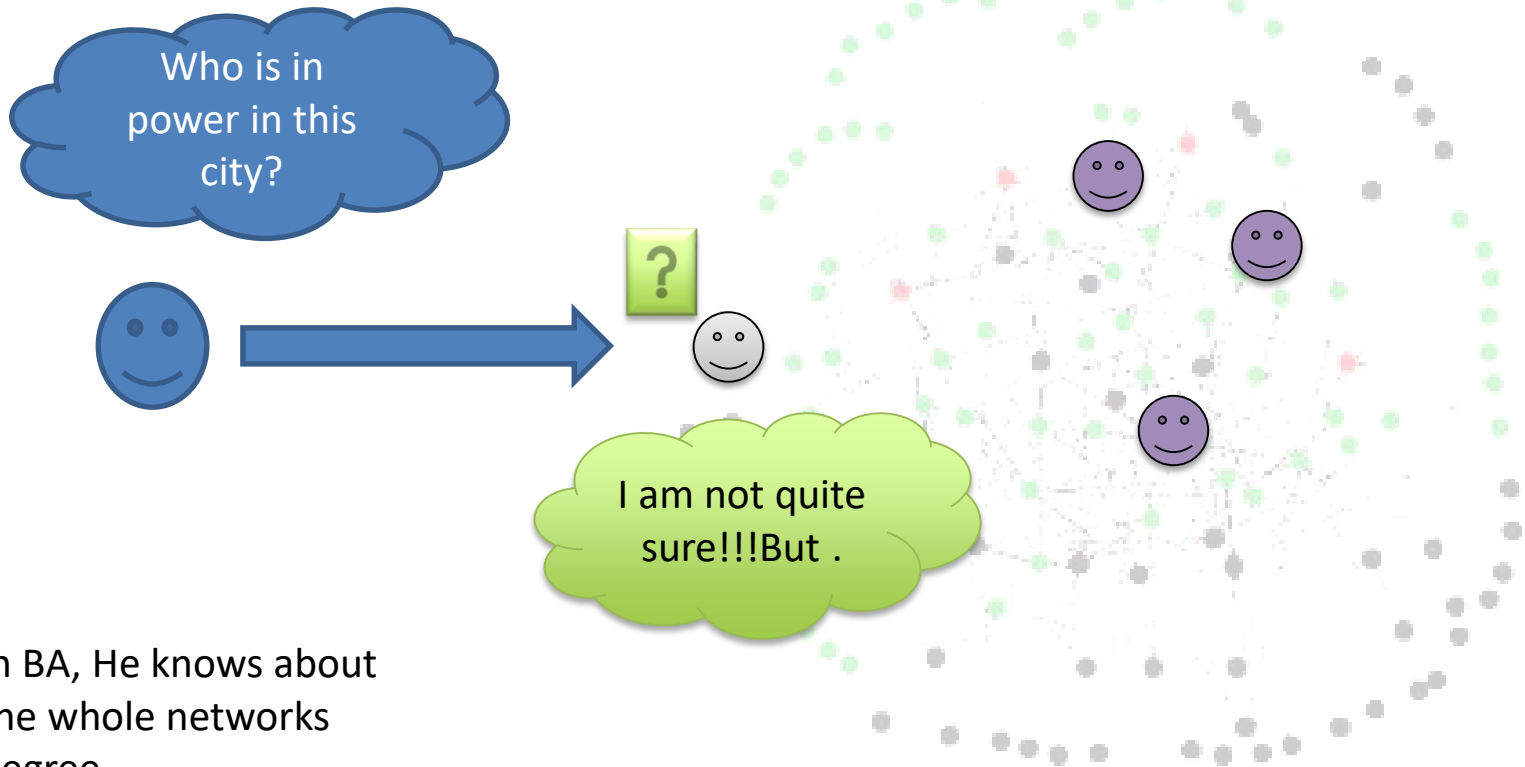
The steps of the growth of the network according to the Barabasi–Albert model ($m=2$)

Preferential attachment model

$$\frac{\partial k_i}{\partial t} = m \Pi(k_i) = m \frac{k_i}{\sum_{j=1}^{N-1} k_j}$$



Low Transparency

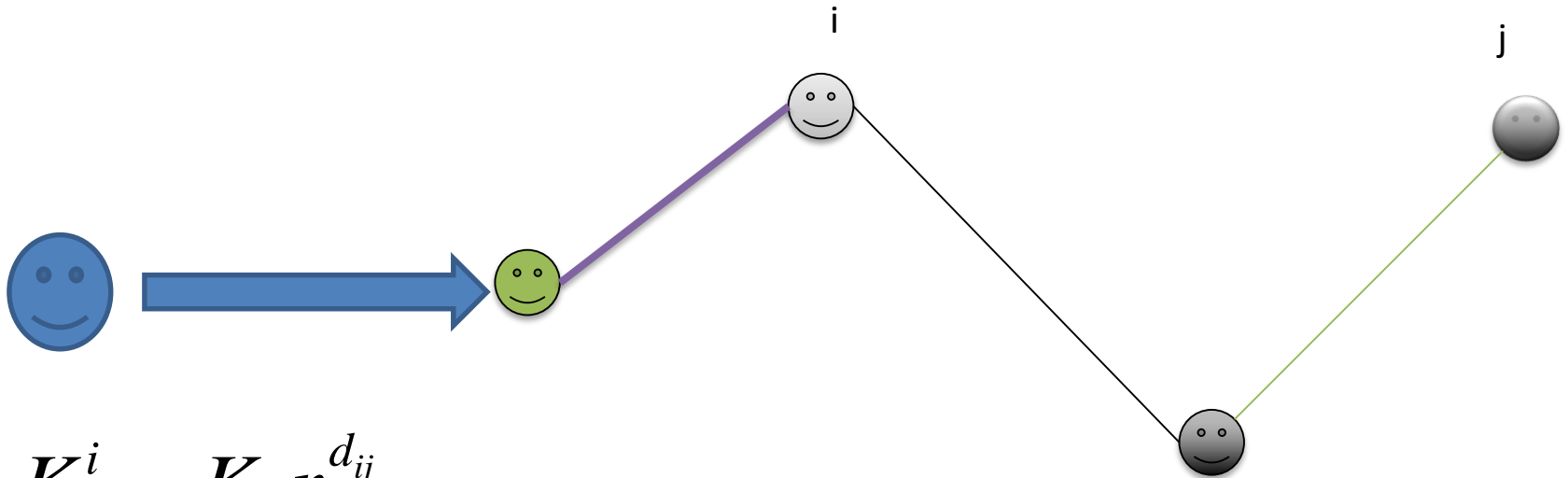


Transparency Effect in the Emergence of Monopolies in Social Networks

Journal of Artificial Societies and Social Simulation 16 (1) 1 (2013)

Amirhossein Shirazi, Ali Namaki, Amir Ahmad Roohi and Gholamreza Jafari

Low transparency model



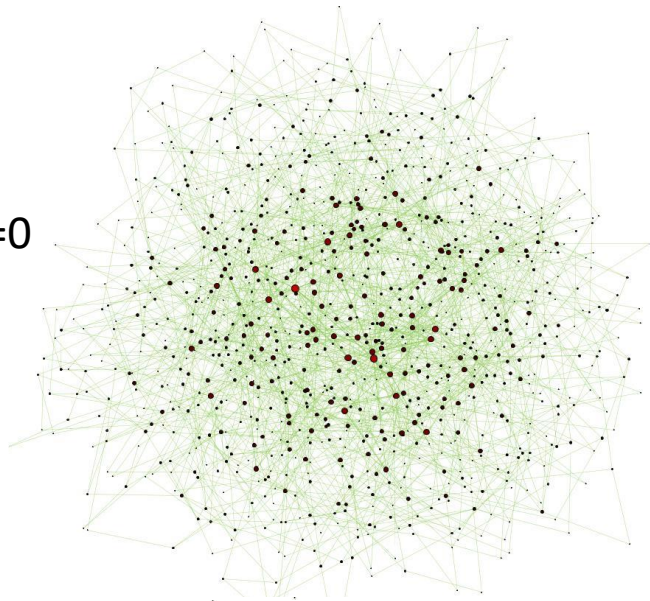
$$K_j^i = K_j r^{d_{ij}}$$

$$\Pi(k_j^i) = \frac{k_j^i}{\sum k_j^i}$$

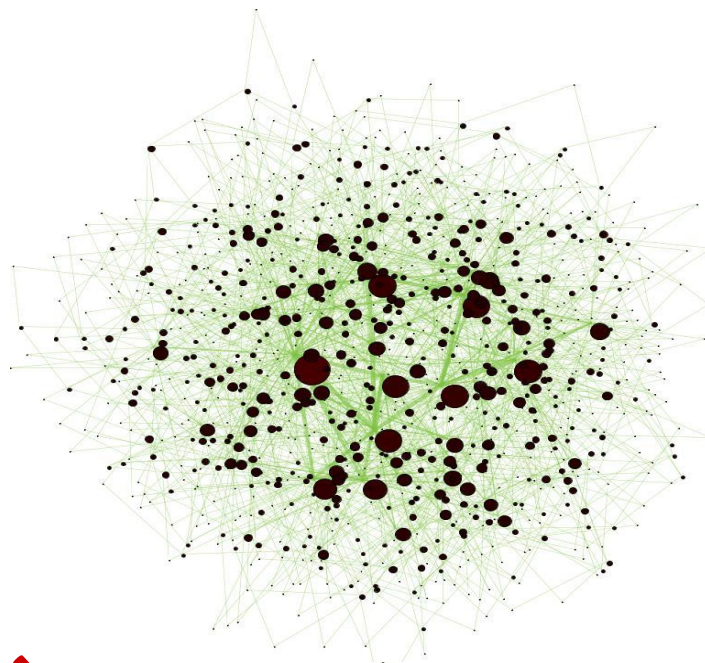
d_{ij} Distance between i and j

r Transparency value

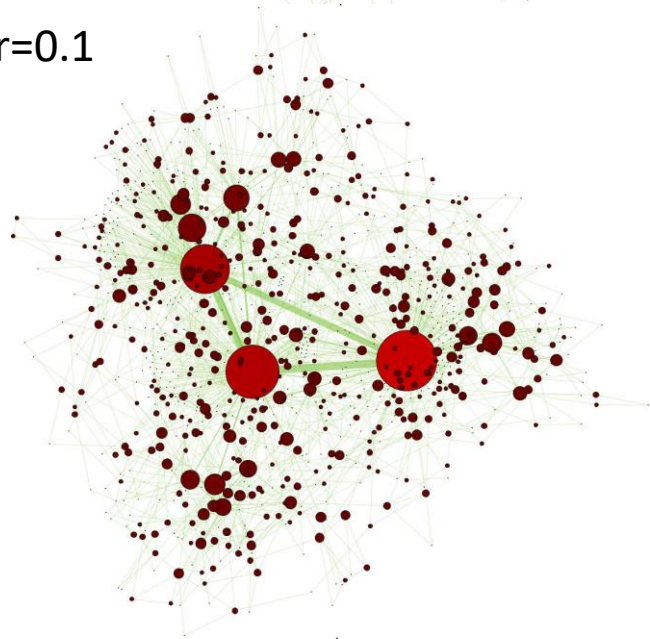
$r=0$



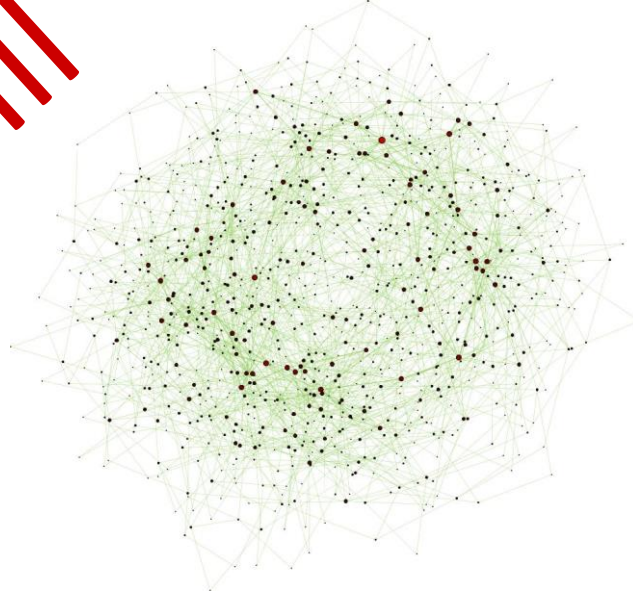
$r=1$



$r=0.1$

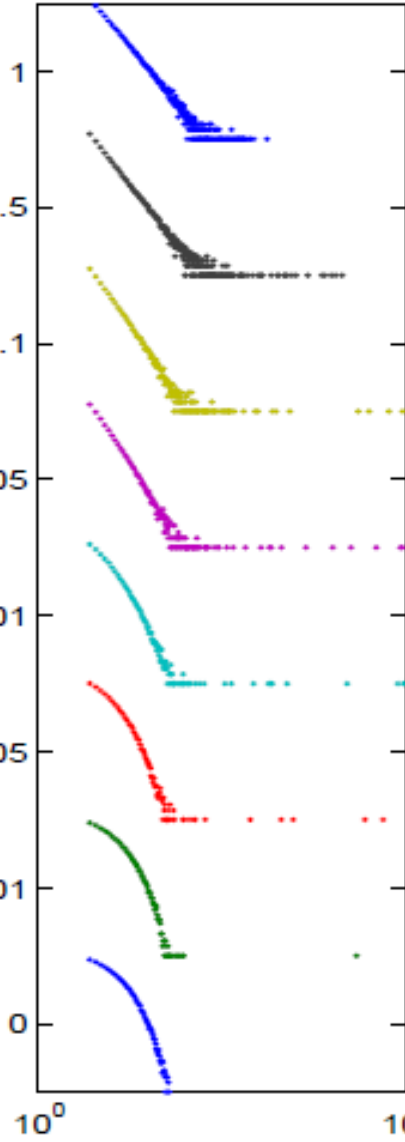


$r=5$

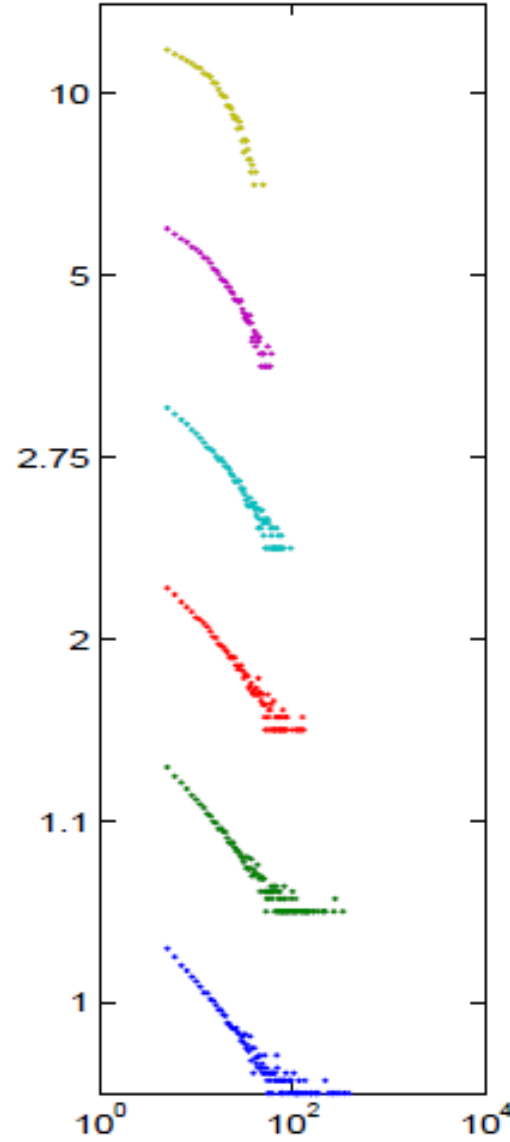


$P(k)$

BA Model



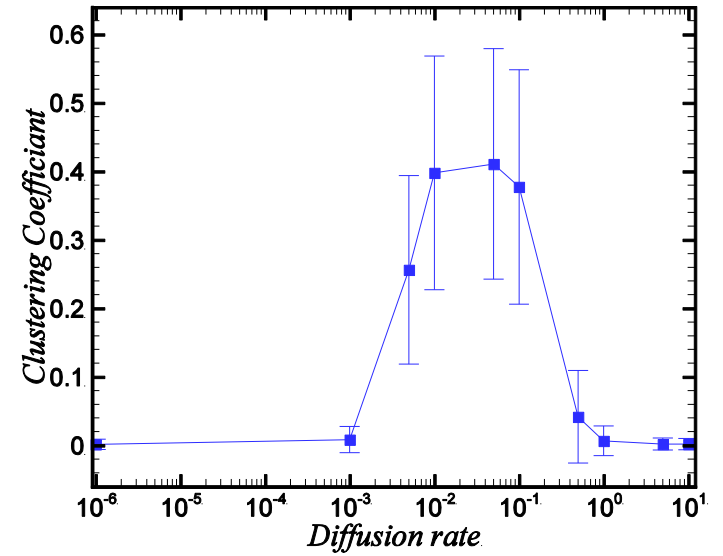
Low information



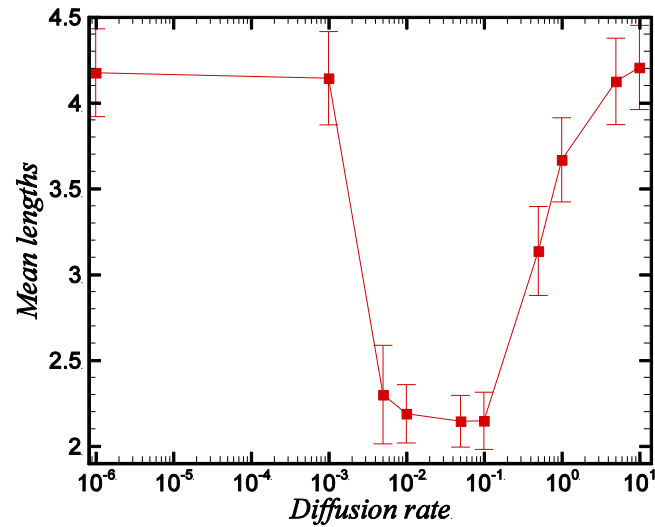
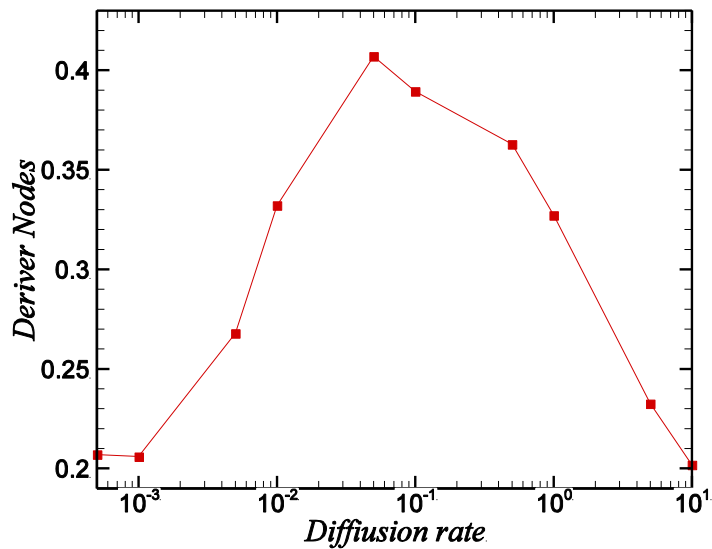
Fake information

Clustering

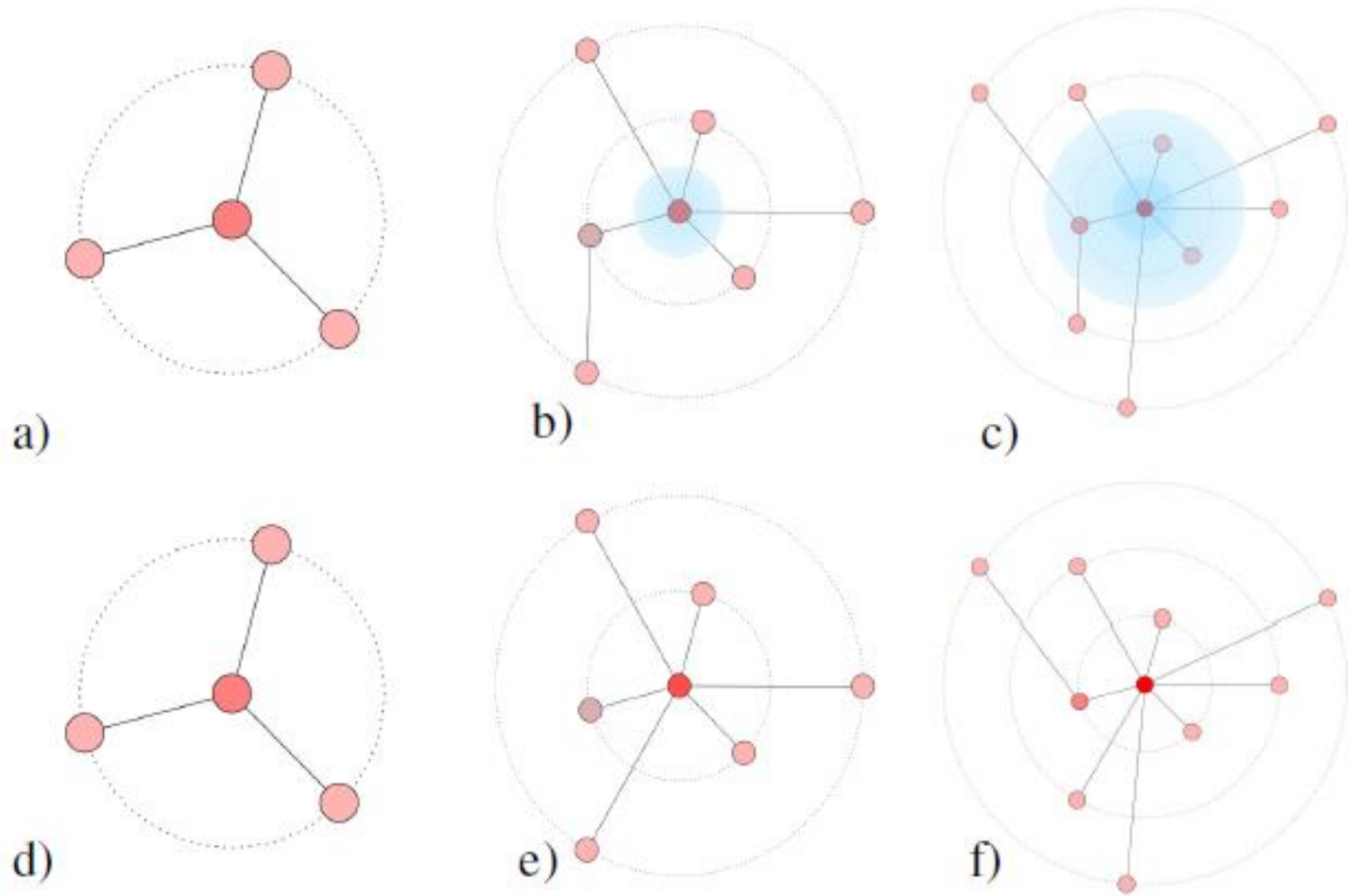
Mean Length



Controllability



Aged nodes



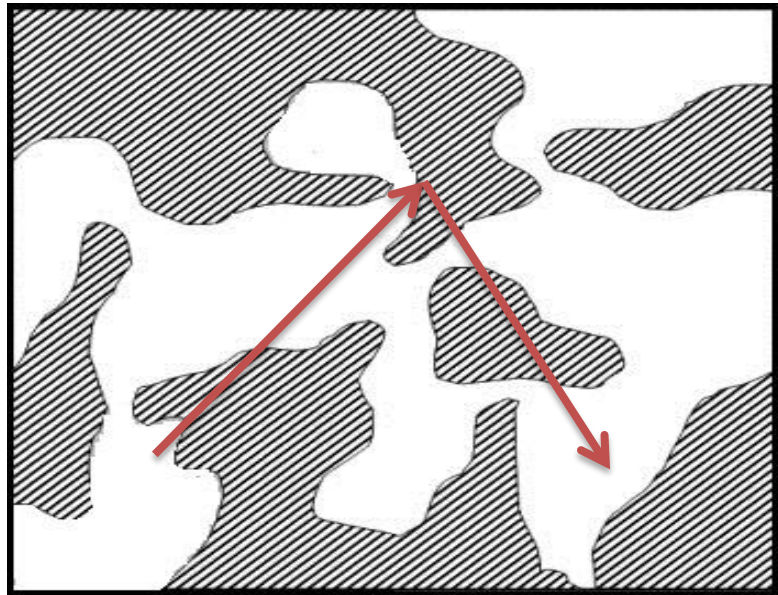
A letter of Hopital in 1696



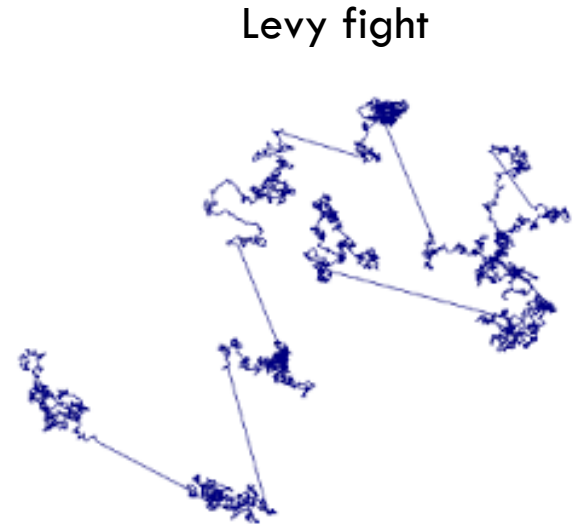
[Guillaume de l'Hôpital](#)

Born: 1661 in Paris, France

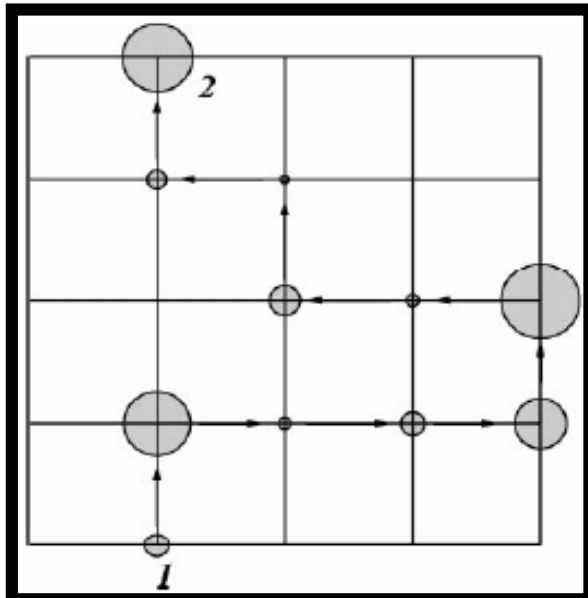
Died: 2 February 1704 in Paris, France



Fractional space



Levy flight

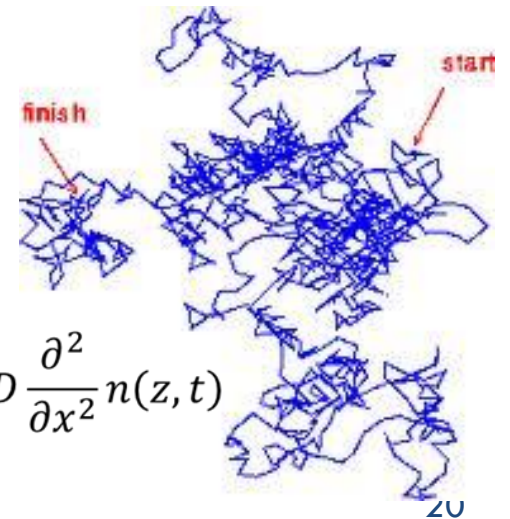


$$\frac{\partial^\beta n(z, t)}{\partial^\beta t} = D \frac{\partial^\alpha n(z, t)}{\partial^\alpha x}$$

The Past & the Future

Fractional time

$$\frac{\partial}{\partial t} n(z, t) = D \frac{\partial^2}{\partial x^2} n(z, t)$$



Random walk

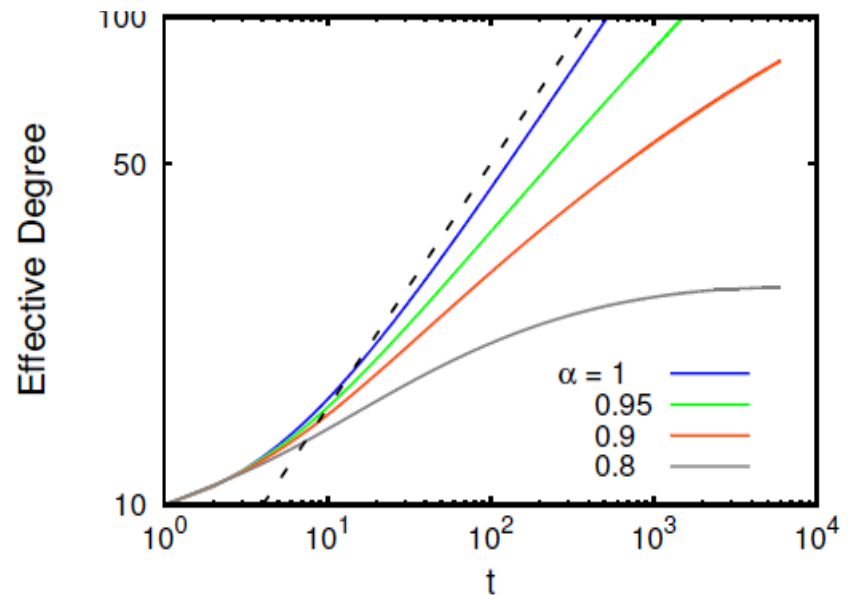
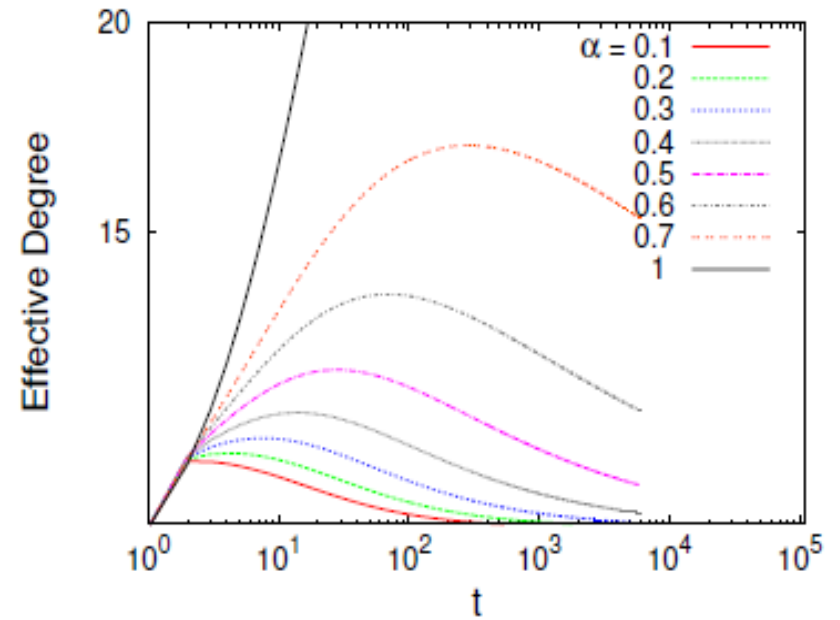
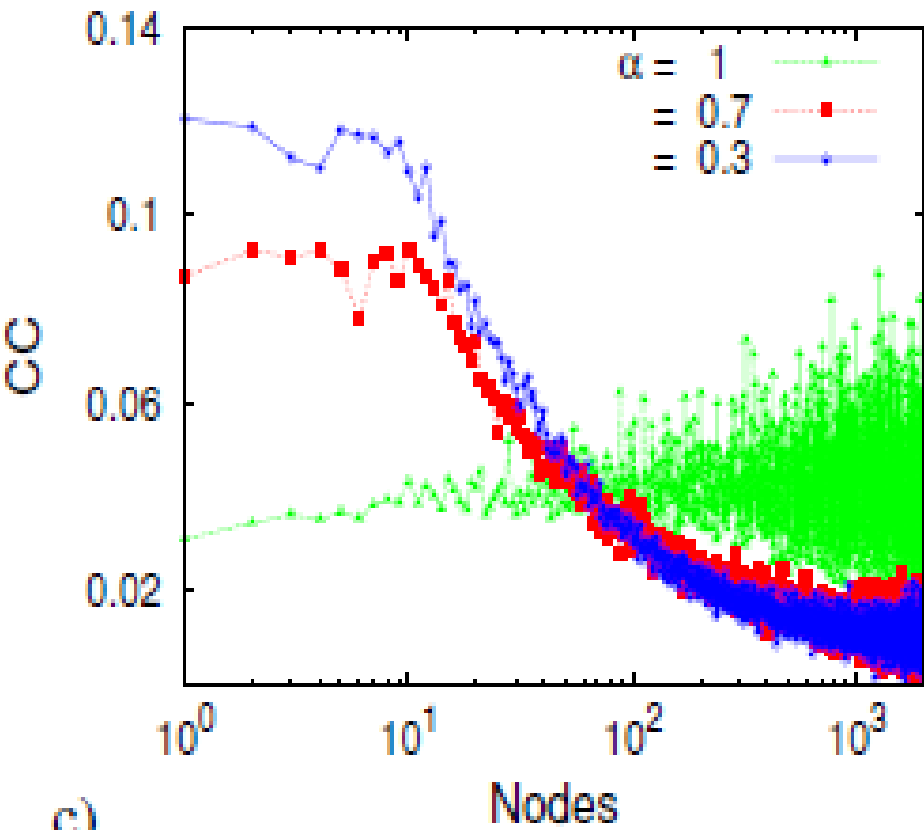
$$\frac{dk_i(t)}{dt} = \int_{t_0}^t dt' \kappa(t-t') \frac{mk_i(t')}{\sum_j^{t'} k_j(t')}$$

$$\frac{dk_i(t)}{dt} = \frac{1}{\Gamma(\alpha-1)} \int_{t_0}^t dt' (t-t')^{\alpha-2} \frac{mk_i(t')}{\sum_j^{t'} k_j(t')}.$$

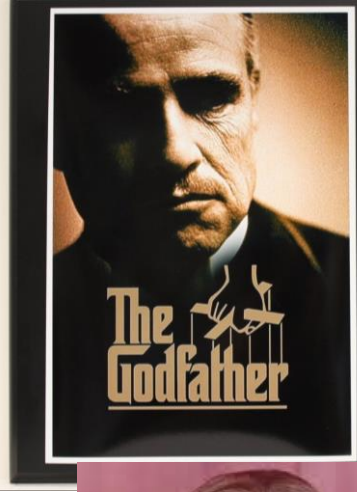
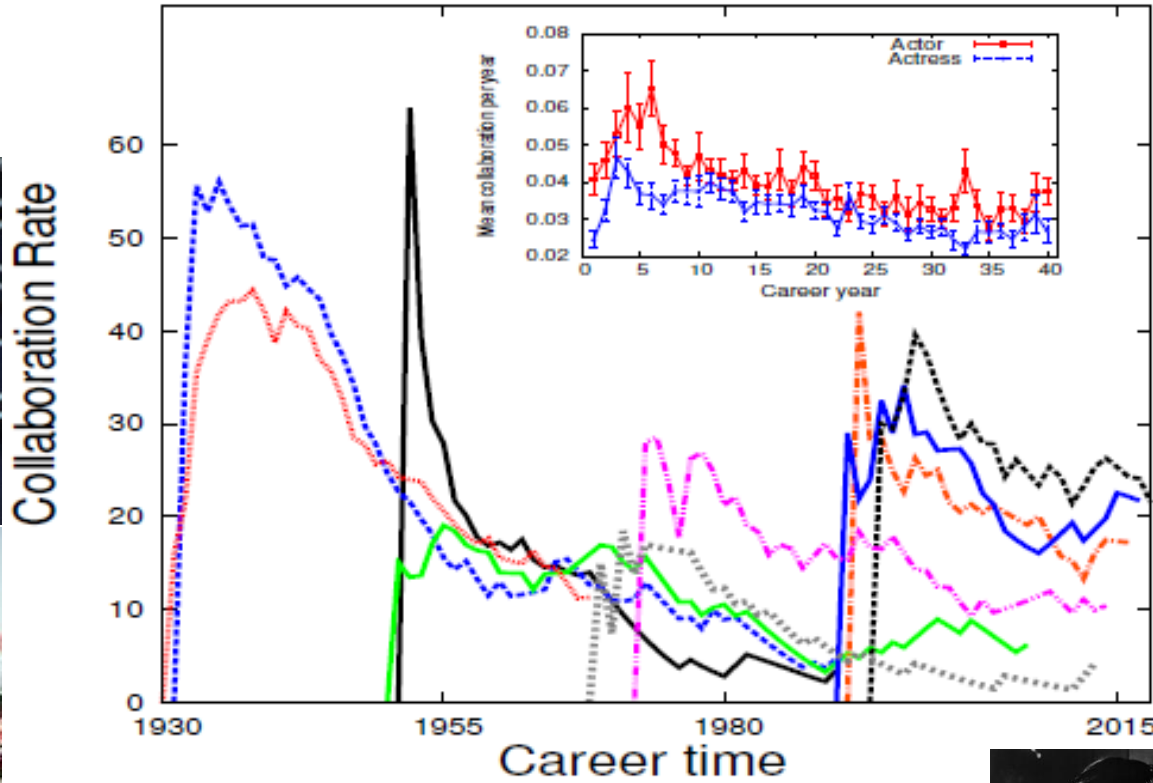
$${}^c D_t^\alpha [k_i(t)] = \frac{mk_i(t)}{\sum_j^t k_j(t)}$$

$$k_n = k_0 + h^\alpha \sum_{j=0}^{n-1} b_{n-j-1} \frac{mk_j}{\sum_j^t k_j(t)}$$

Effective Degree



Oscar winners activities



Enjoy your time