Basics of randomness

Randomness — lack of predictability (example — coin tossing).

Even if single events are not predictable, their statistics in many cases is.

Chance ~ coincidence = concurrent uncorrelated causes.

Example: bridge ruined under weight of people; there was cause why people were there (it's not random), there was cause why bridge ruined (it's not random too), but only conjunction of this events is unpredictable.

Free will: refers to our choice (it's not random for person who's doing it, but it it's not predictable for others who don't know this person).

First persons trying scientific approach to randomness:
Cardano, Liber de ludo aleae (1564); //ludo aleae – dice tossing (lat.)
Fermat – **Pascal** letters (1654);
Huygens, De ratiociniis in ludo aleae (1657).
Bell curve – first discovered by:
De Moivre by tossing many coins (1733);
//see also his
http://en.wikipedia.org/wiki/The_Doctrine_of_Chances
introducing the concept of normal distributions as approximations to binomial distributions;
Laplace by measuring errors (1812)
NB: we can't know the exact result but we can quanify rigorously how far we are from it.

принципиальная недетерминистичность статистики по сравнению с остальной математикой, ее поздняя формализация (даже позже, чем ОТО/СТО и квантовая механика)

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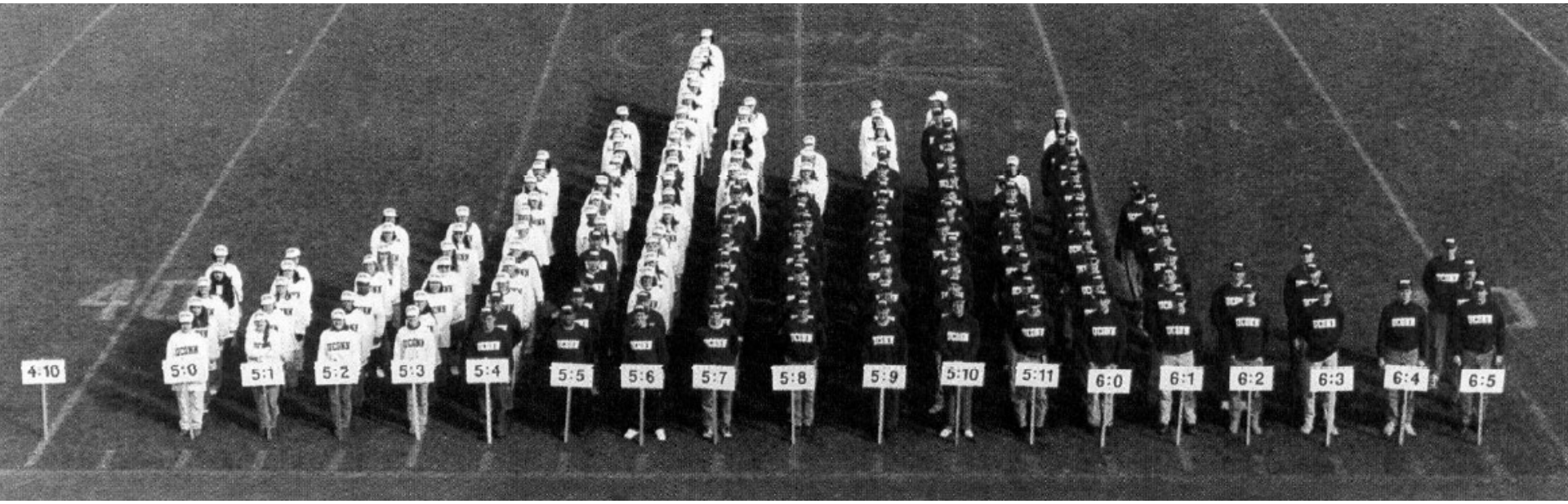
первый эмпирический взрыв: стык XVIII-XIX вв., нормальное распределение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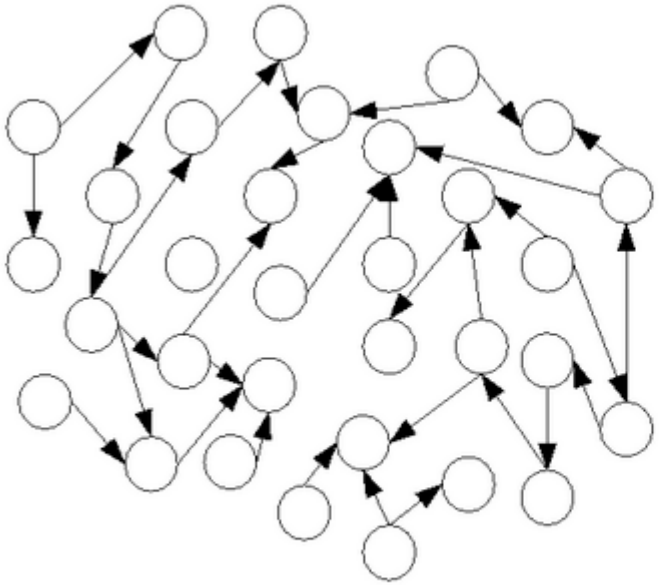
принципиальная недетерминистичность статистики по сравнению с остальной математикой, ее поздняя формализация (даже позже, чем ОТО/СТО и квантовая механика)

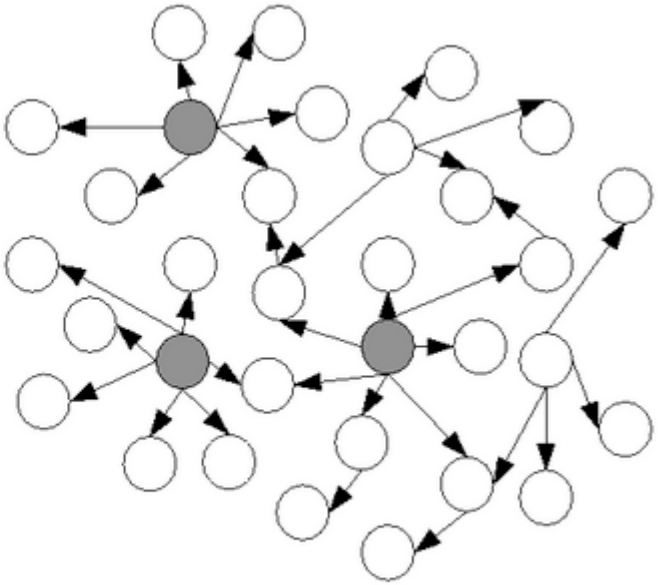
первый эмпирический взрыв: стык XVIII-XIX вв., нормальное распределение

неожиданная эмпирика, пришедшая в конце 90-х годов XX в.

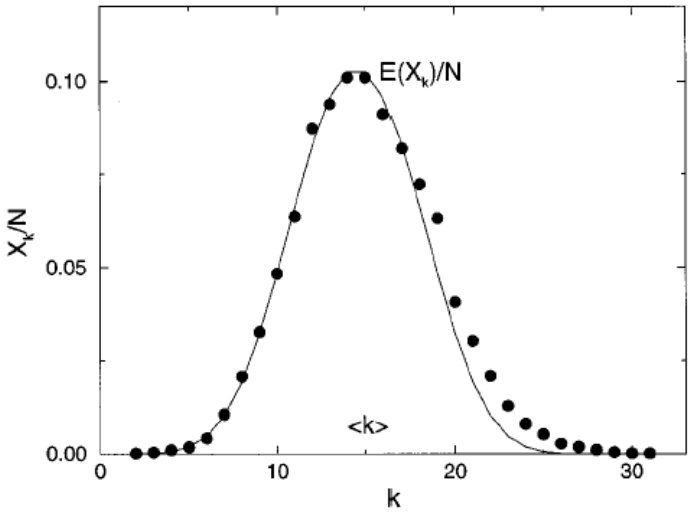
А.Л. Барабаши: идея безмасштабных сетей

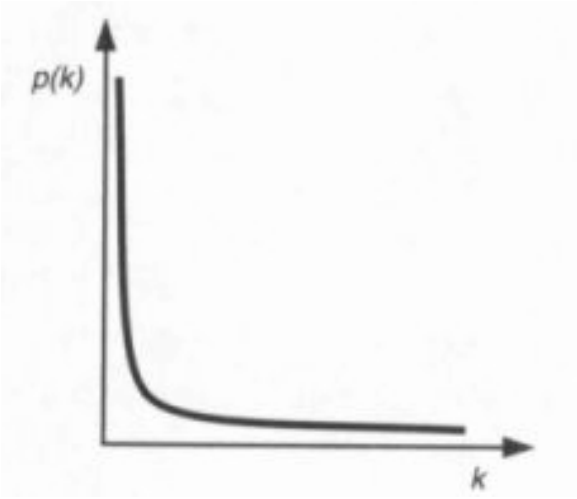


(a) Random network



(b) Scale-free network



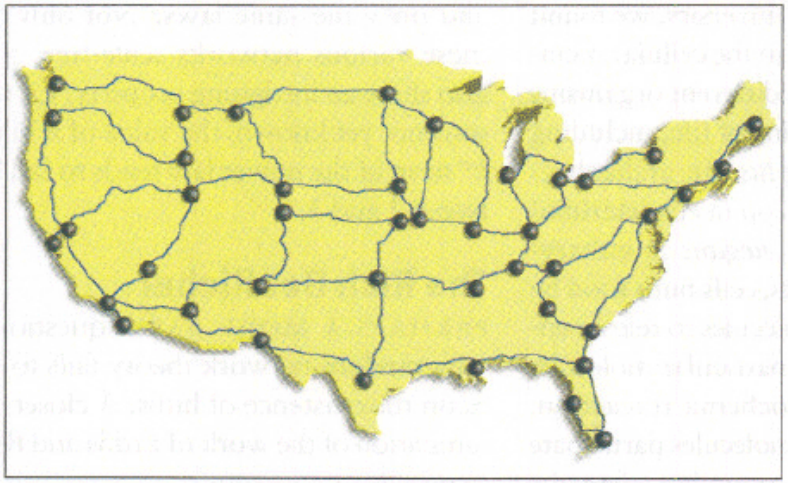


RANDOM VERSUS SCALE-FREE NETWORKS

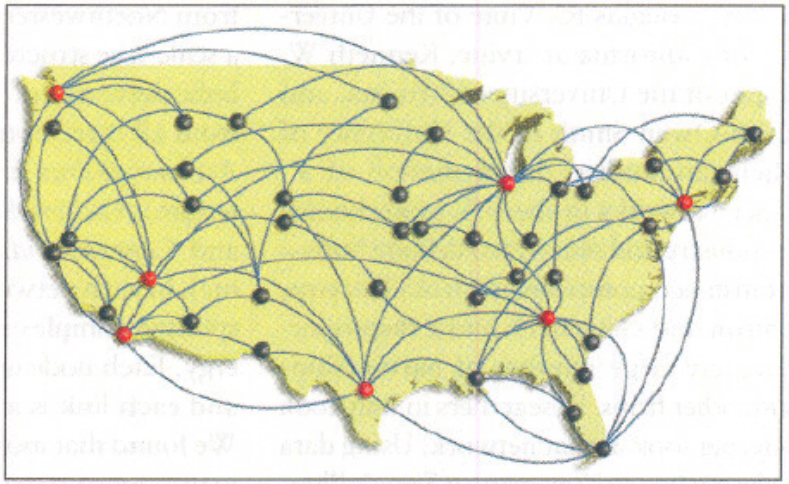
RANDOM NETWORKS, which resemble the U.S. highway system (*simplified in left map*), consist of nodes with randomly placed connections. In such systems, a plot of the distribution of node linkages will follow a bell-shaped curve (*left graph*), with most nodes having approximately the same number of links.

In contrast, scale-free networks, which resemble the U.S. airline system (*simplified in right map*), contain hubs (*red*)—nodes with a very high number of links. In such networks, the distribution of node linkages follows a power law (*center graph*) in that most nodes have just a few connections and some have a tremendous number of links. In that sense, the system has no "scale." The defining characteristic of such networks is that the distribution of links, if plotted on a double-logarithmic scale (*right graph*), results in a straight line.

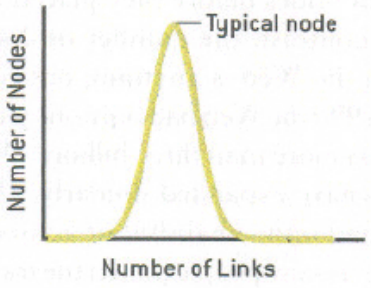
Random Network



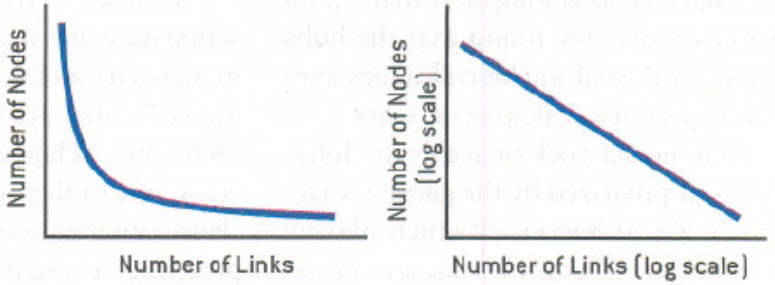
Scale-Free Network



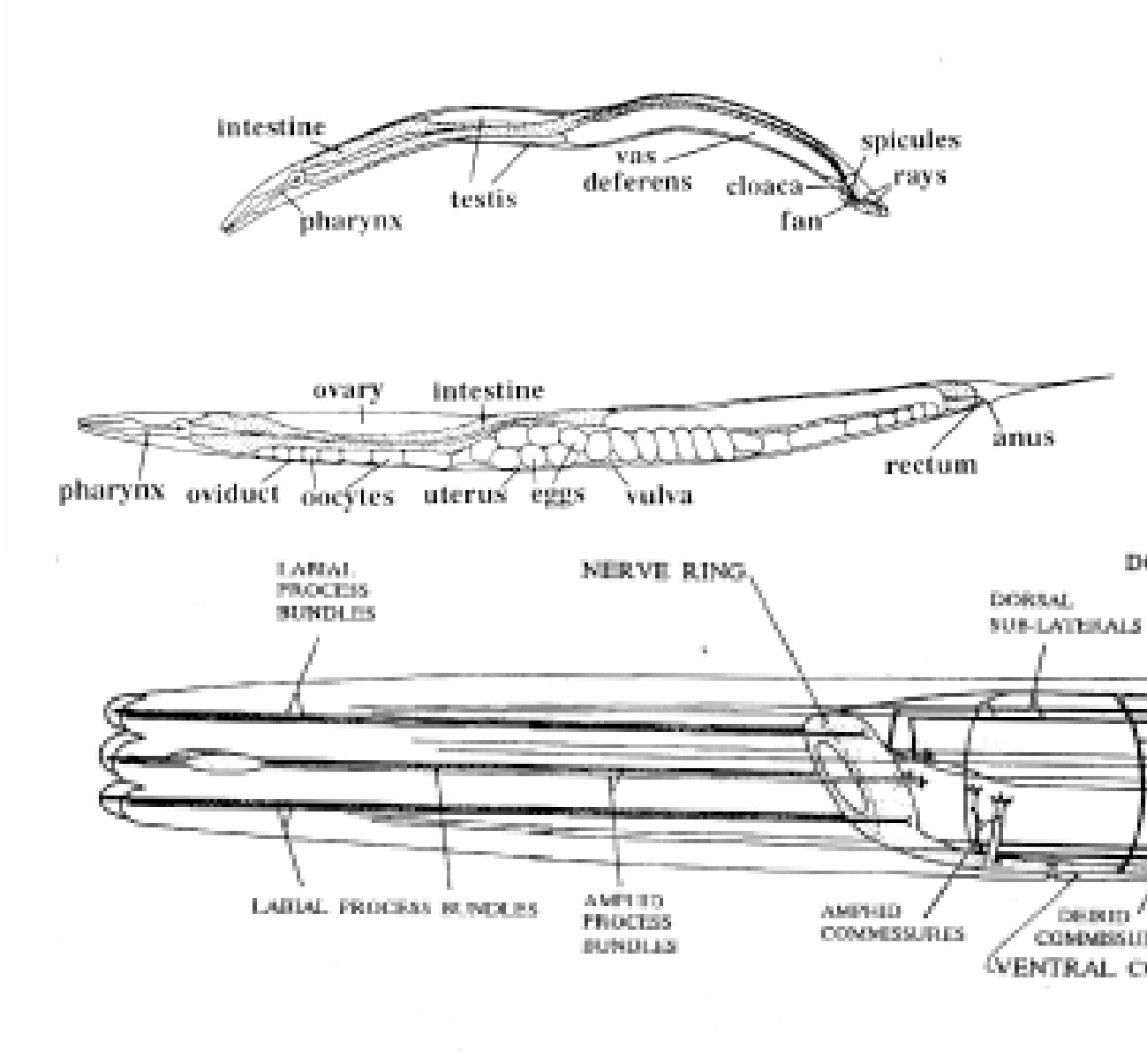
Bell Curve Distribution of Node Linkages



Power Law Distribution of Node Linkages



C. Elegans


intestine
pharynx
testis
vas deferens
cloaca
fan
spicules
rays
ovary
intestine
pharynx
oviduct
oocytes
uterus
eggs
vulva
anus
rectum
LABIAL PROCESS BUNDLES
NERVE RING
DORSAL SUB-LATERALS
DORSAL CORD
COMMISSURE ARISING FROM VENTRAL CORD
LABIAL PROCESS BUNDLES
AMPHID PROCESS BUNDLES
AMPHID COMMISSURES
DORSAL COMMISSURES
VENTRAL SUB-LATERALS
VENTRAL CORD

как это окружает нас в жизни?

Examples of Scale-Free Networks

NETWORK	NODES	LINKS
Cellular metabolism	Molecules involved in burning food for energy	Participation in the same biochemical reaction
Hollywood	Actors	Appearance in the same movie
Internet	Routers	Optical and other physical connections
Protein regulatory network	Proteins that help to regulate a cell's activities	Interactions among proteins
Research collaborations	Scientists	Co-authorship of papers
Sexual relationships	People	Sexual contact
World Wide Web	Web pages	URLs