Six degrees:
The science of a connected age

By Duncan J. Watts

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Overview

- About the author
- About the book
- Networks and network theory
- Small world problem
- Overview of some examples
- Impressions
Duncan J. Watts

- From Australia
  - University College, University of New South Wales, Australian Defence Force Academy (Physics).
- **Went to Cornell**
  - Ph.D. 1997 Cornell University (Theoretical and Applied Mechanics)
  - Steven Strogatz - advisor (mathematician interested in biology, physics, and sociology)
  - Snowy tree crickets - biological oscillator
- Lazarsfeld Center for the Social Sciences, Columbia University
- Santa Fe Institute
- Sloan School of Management, MIT.
- Department of Sociology, Columbia University
- Collective Dynamics Group (research program in ISERP)
Book Overview

- Ch 1 - setup: how he became interested - key concepts
- Ch 2 - background
- Ch 3, 4, 5 - creation and implications of various models
- Ch 6 - spreading of diseases and computer viruses
- Ch 7, 8 - social contagion
- Ch 9 - organizational robustness
- Ch 10 - overview
Networks

A collection of objects connected to each other in some fashion

- Properties of networks
  - Populations of components that are doing something
  - Structure of relationships affect behavior
  - Dynamic
  - Evolving and self constituting system
  - Affect multiple disciplines
  - Complex set of problems
Small world problem

- "six degrees" property
  - Six degrees from the President
  - Kevin Bacon
  - Party conversation
- Stanley Milgram experiment - 1967
  - Boston to Nebraska
  - First name basis
  - Results were about six
A pure branching network
Clustering
Brief history of network theory

- Paul Erdös & Alfred Rényi - random graphs
- Anatol Rapoport - random-biased net
- Stanley Milgram - "six degrees"
- Mark Granovetter - "strength of weak ties"
- Physicists - spin systems of magnetism
- Social scientists
  - Rational expectations theory (rationality)
  - Herbert Simon (and others) - bounded rationality
Theory of Random Graphs

- Paul Erdös & Alfred Rényi (1951)
- Random graph - network of nodes connected by links in a purely random fashion.
Connectivity of a random graph

- Phase transition at a critical point
- Says important things about the line between connectedness and isolation
- Real networks are not random

![Graph showing phase transition](image-url)
Random-biased net

- homophily
Key introductory concepts

- Introduction to the systems problem - Cascading failures
  - System is built on components whose individual behavior is relatively well understood

- Emergence
  - How does individual behavior aggregate to collective behavior?

- Synchrony
  - Study of biological oscillators

- Clustering
  - Clustering breeds redundancy
Examples

- Epidemics and failures
  - Internet viruses
  - Disease - epidemics
- Madness of crowds
- Thresholds and cascades
- Innovation / adaptation / recovery
Impressions

- Overview of network theory
- How network theory can be applied
- Future areas for network theory
- Insight into theory development

- Complex and difficult concepts
- Written well with good stories, clear examples, and useful diagrams
Questions