Why Studying Complex Networks

Introduction to Network Science

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Topic 02

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Sources

- Albert László Barabási: Network Science. Cambridge University Press, 2016.
  - Chapter 01, Chapter 02
- Filippo Menczer, Santo Fortunato, and Clayton A. Davis. A First Course in Network Science. Cambridge University Press, 2020.
  - Chapter 00
- URLs cited in the footer of specific slides

What could complex networks have in common? Why those regularities could be relevant? How would you find out what they are?

Universality of complex networks

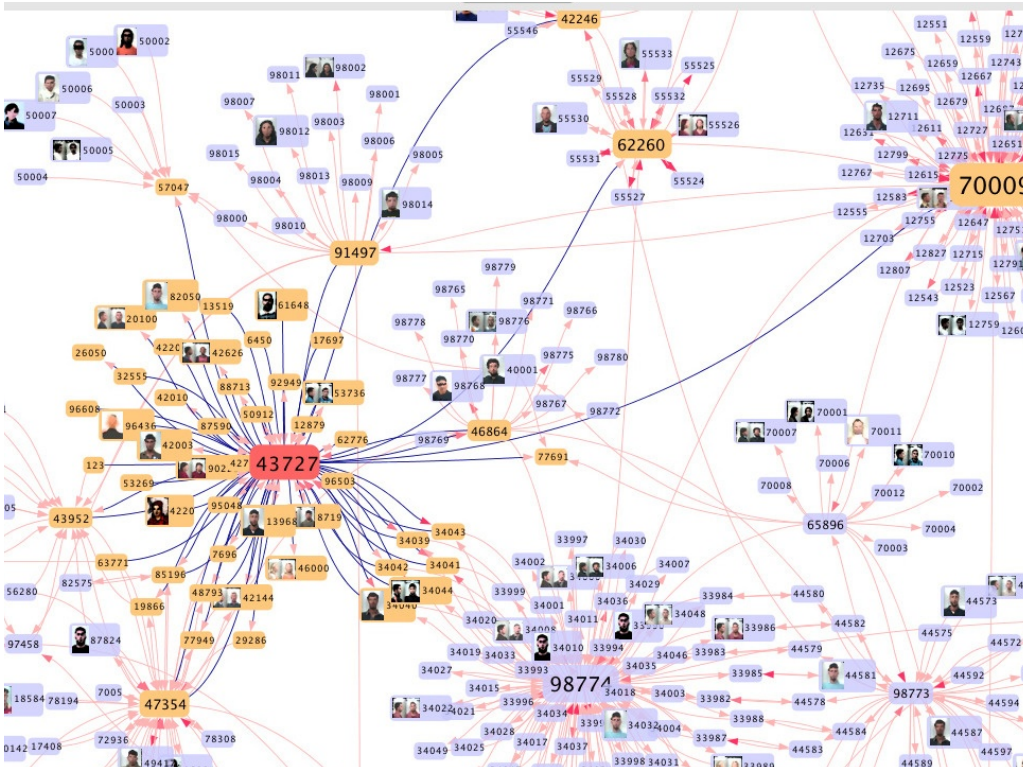
"A key discovery of network science is that the architectures of networks emerging in various domains of science, nature and technology are similar to each other, a consequence of being governed by the same organizing principles."

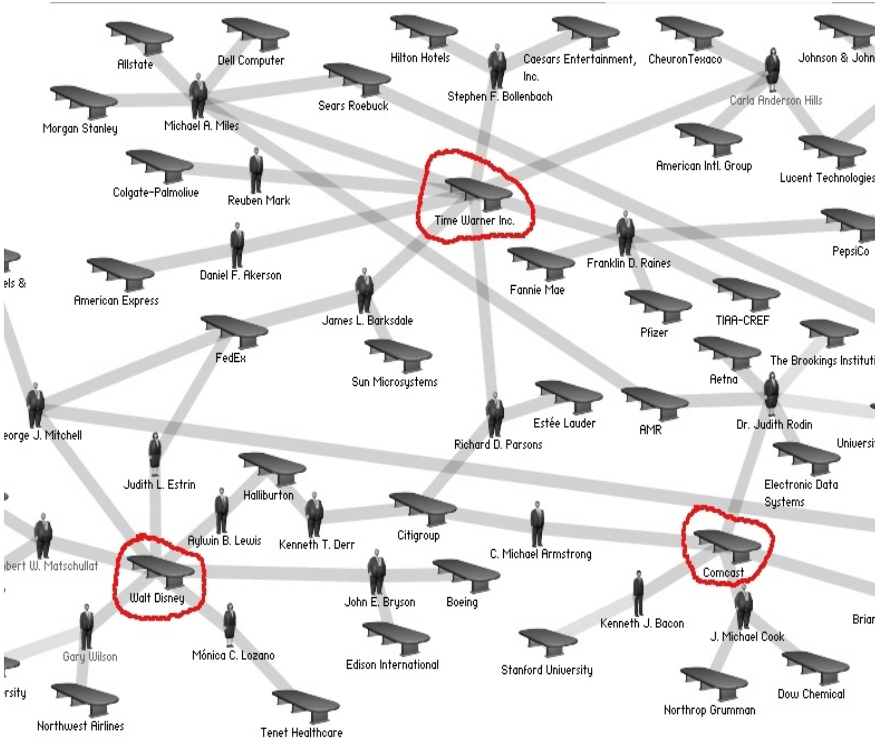
(Barabási 2016)

Characteristics of network science

- **Interdisciplinary**; indeed we often address problems from disciplines other than CS
- **Empirical** and data-driven; it is based on the observation of networks
- Quantitative, mathematical, **computational**

Help fight
organized crime and collusion





https://itnews.iu.edu/articles/2014/complex-networks-researcher-at-iu-fighting-crime-with-mobile-phone-data.php

https://en.wikipedia.org/wiki/File:Media_corporation_interlocks_-_2004.jpg

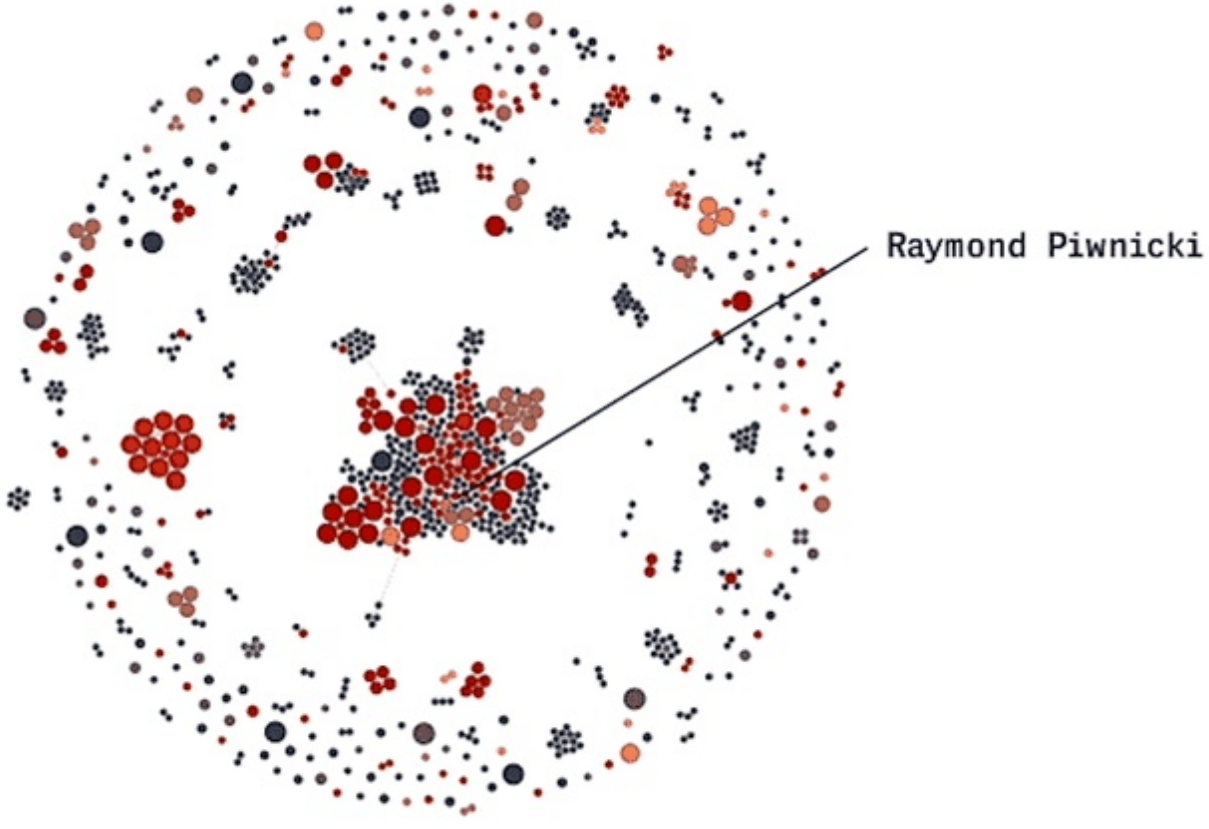
Help fight corruption

The Intercept_

BAD CHICAGO COPS SPREAD THEIR MISCONDUCT LIKE A DISEASE

Rob Arthur

August 16 2018, 3:03 p.m.

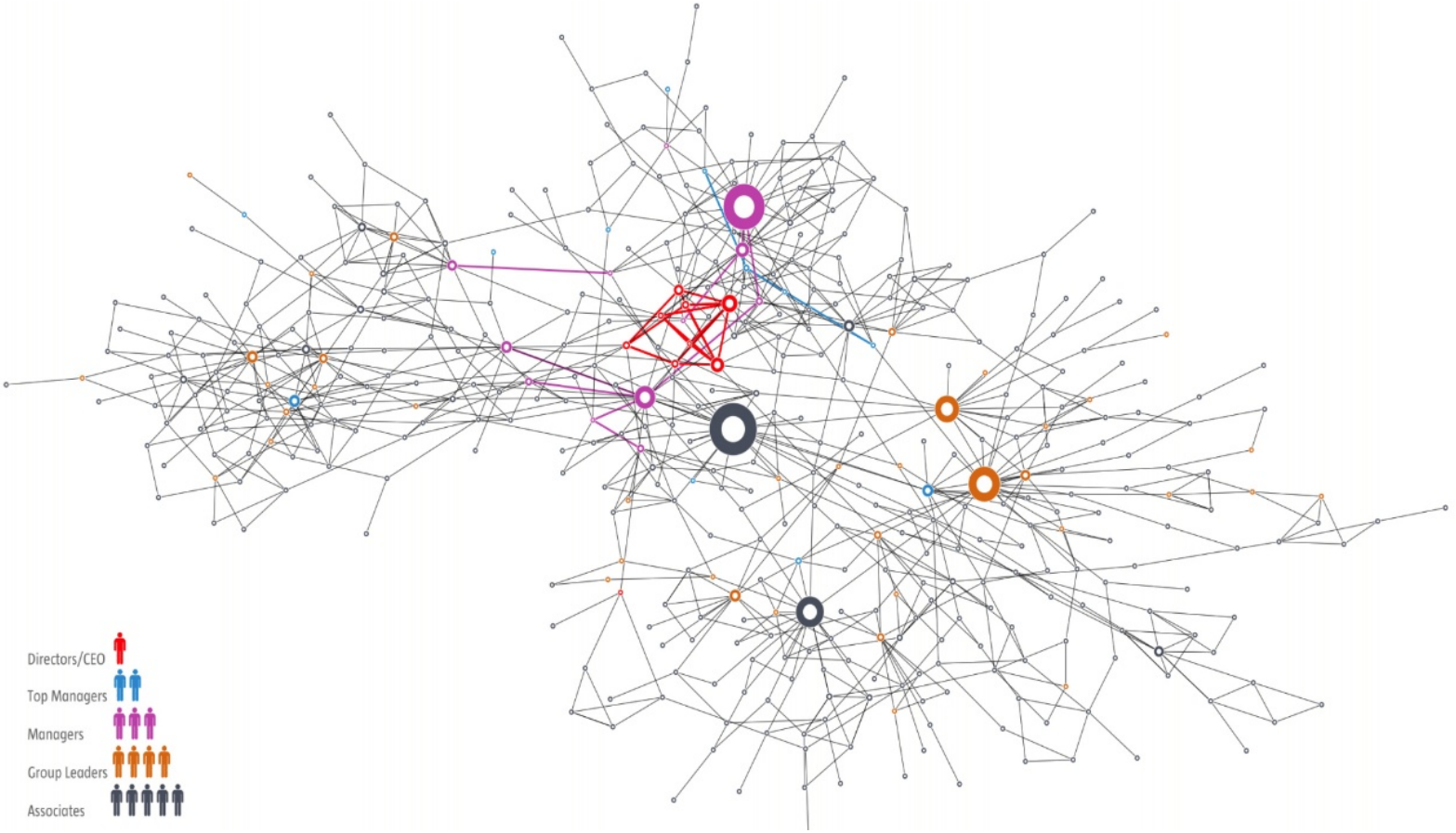


https://theintercept.com/2018/08/16/chicago-police-misconduct-social-network/

Help to forecast epidemics

https://www.youtube.com/watch?v=mm2u9RKwgsY

Help understand an organization, a society, or a brain



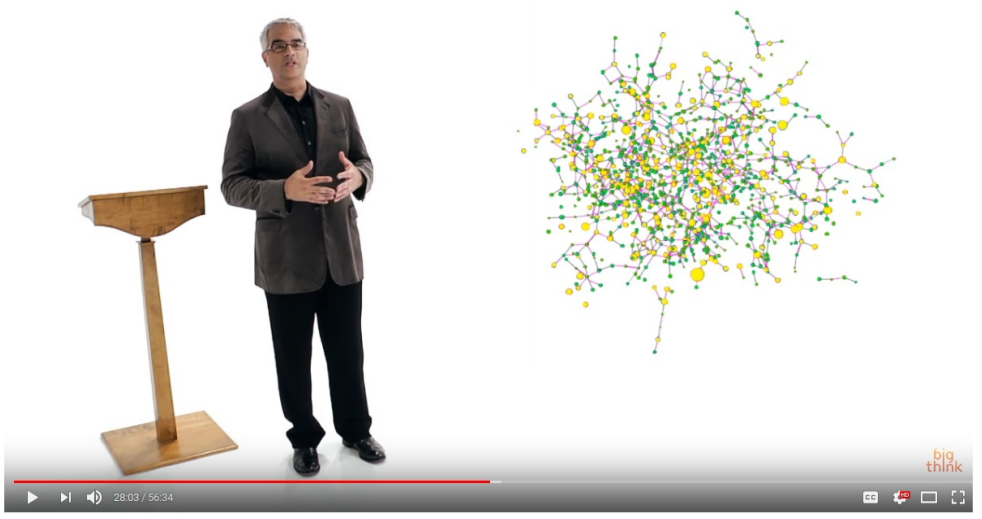
What can you do with this?

- Help fight organized crime and corruption
- Help to forecast epidemics
- Help to understand an organization, a society, or a brain
- Help design new treatments and drugs

What can you do with this?

- Help design new treatments and drugs
- …

Highly recommended:
Nicholas Christakis
(one hour lecture)



https://www.youtube.com/watch?v=wadBvDPeE4E

What we will learn

- To describe a network in formal terms
- To identify it as such and characterize it
- To visualize different networks
- To operate with networks programmatically
- To find important nodes and communities
- To make discoveries or help others make them
- **Much more (to a large extent, it’s up to you!)**

How we will learn

- Theory sessions:
  - Help you understand how to model complex networks
  - Help you find important nodes, communities, and track influence
  - Do some simple (and not so simple) exercises to check that you understood correctly each concept, and to help you remember
- Practice sessions:
  - Help you work with complex networks
  - Manage and analyze graphs in Python
- **My focus is on what I think has value for you as a data scientist**

Summary

Things to remember

- Applications of complex networks analysis