A primer on network analysis for business

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2017-12-08

Table of Contents

last modified: 2017-10-06

1. Definitions

A network is a dataset made of entities and their relations

Scientists use the term "graph" to discuss networks.

Figure 1. This is a network

a. Social networks

As users, we are very familiar with one type of networks - social networks:

Figure 2. source: http://www.minanacheva.com/getting-visual-with-facebook-data/

b. Other networks

It is important to realize that networks cover more than relations between humans:

For example, it is possible to imagine a network made out of cooking recipes. 2 ingredients are

connected if they appear frequently in the same recipes.

Scanning all recipes and their ingredients from a website of cooking recipes, this gives:

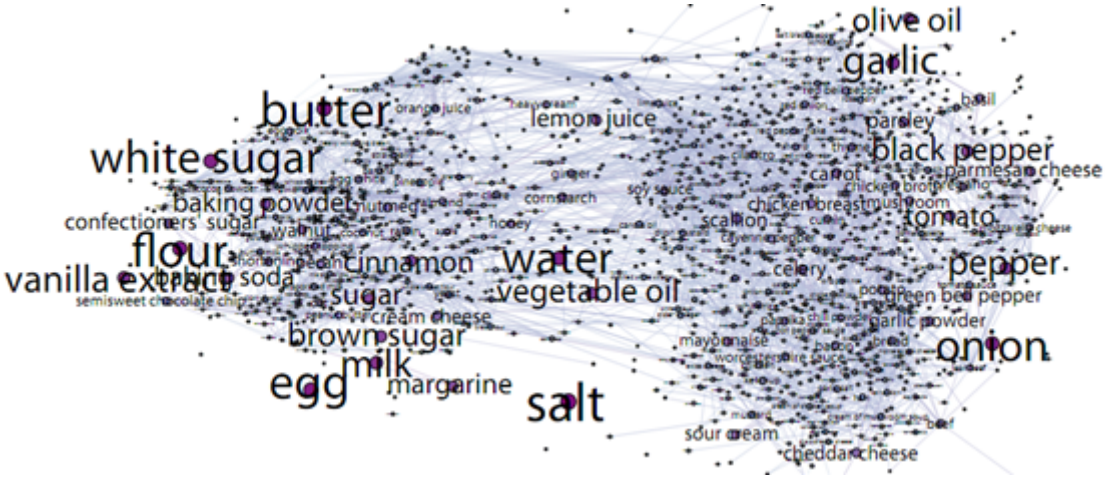


Figure 3. source: http://arxiv.org/abs/1111.3919

Semantic networks are another broad category of networks. The method is the same: we need to find a way to "relate" wors in a text, then we get a network.

The general idea is the same as in cooking recipes: 2 terms of a text will be connected in the network if they frequently appeared in same paragraphs.

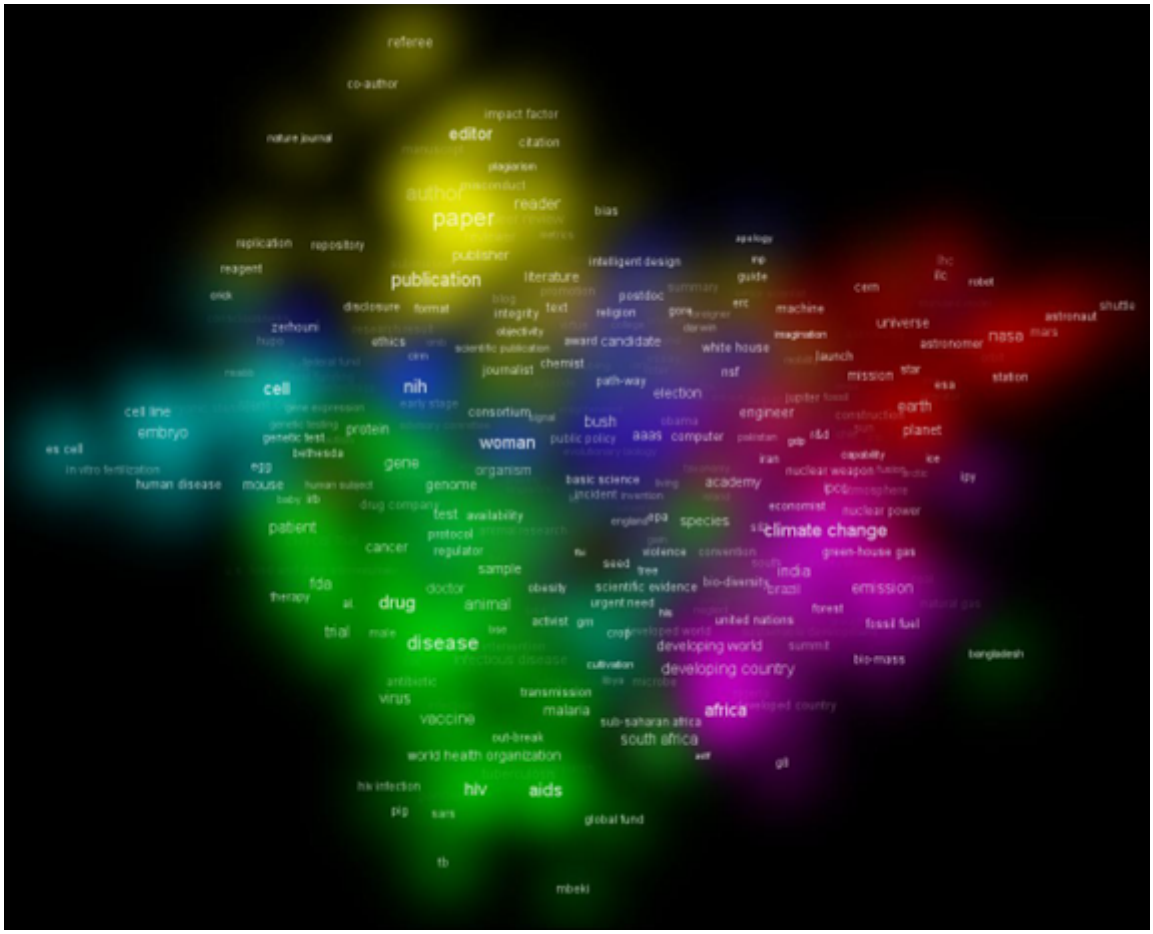


Figure 4. source: http://www.nature.com/nature/journal/v463/n7278/full/463157a.html

c. How big can networks be?

With a surge in computing power in the age of big data, and the adequate NOSQL databases (such as Neo4J or OrientDB), we can deal with huge networks:

For example, "The Anatomy of the Facebook Social Graph" (2011)

→ study of 721 million active Facebook users and the 69 billion (!) friendship links connecting them.

A limit is quickly reached in terms of visualization: it is hard to fit millions of nodes on a screen. In the next visualization, we can see a network of 90,000 Swedish speakers and their relations on Twitter. The view is very cluttered.

(open the source for an interactive version)

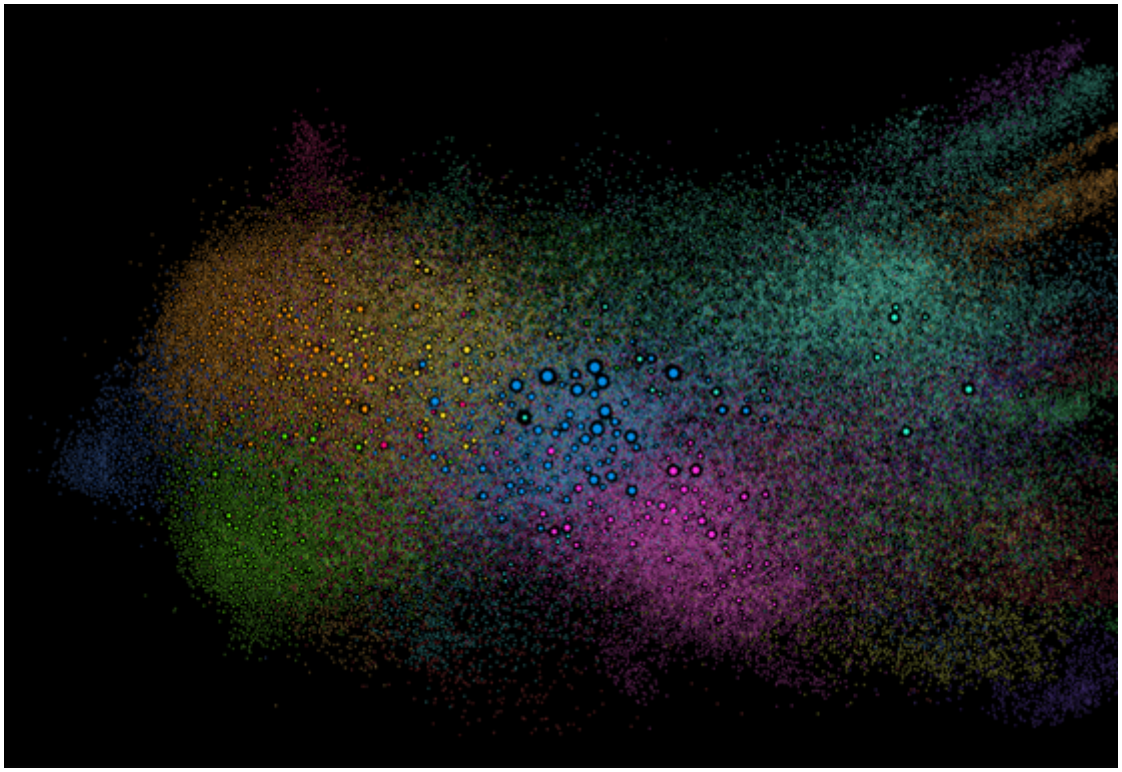


Figure 5. source: http://twittercensus.se/graph2015/

d. How to discuss networks? Some vocabulary

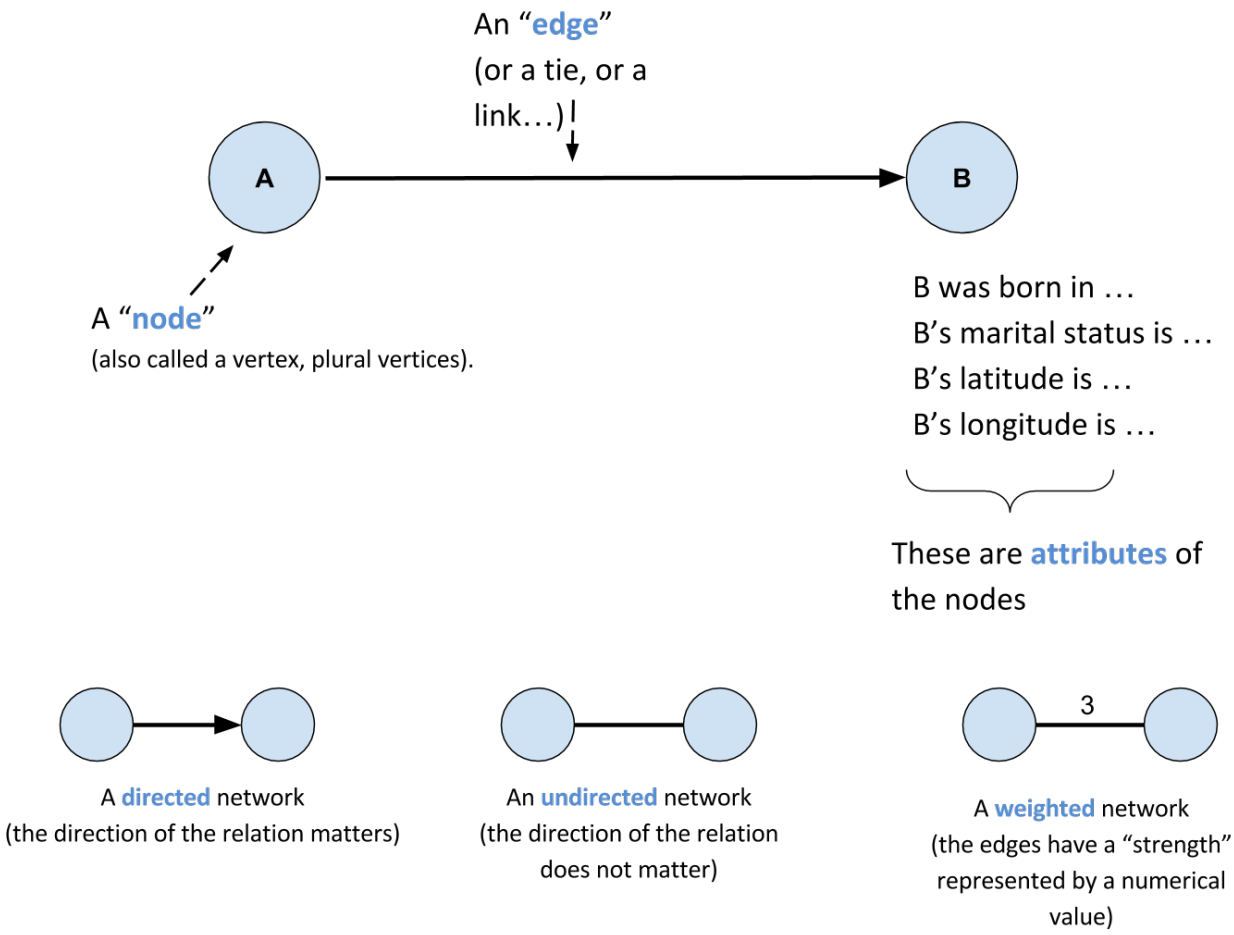


Figure 6. Terminology

2. Networks: what use for business?

a. Segmentation

If a network is made of entities and their relations, then a segment is a subgroup of entities in the network, which has some cohesion or something in common.

This subgroup of nodes in the network is often called a "**community**".

Detecting communities in a network, also called "clustering", consists in finding nodes that have many connections in common.

This is a mathematical and algorithmic procedure, but it is very simple to understand visually:

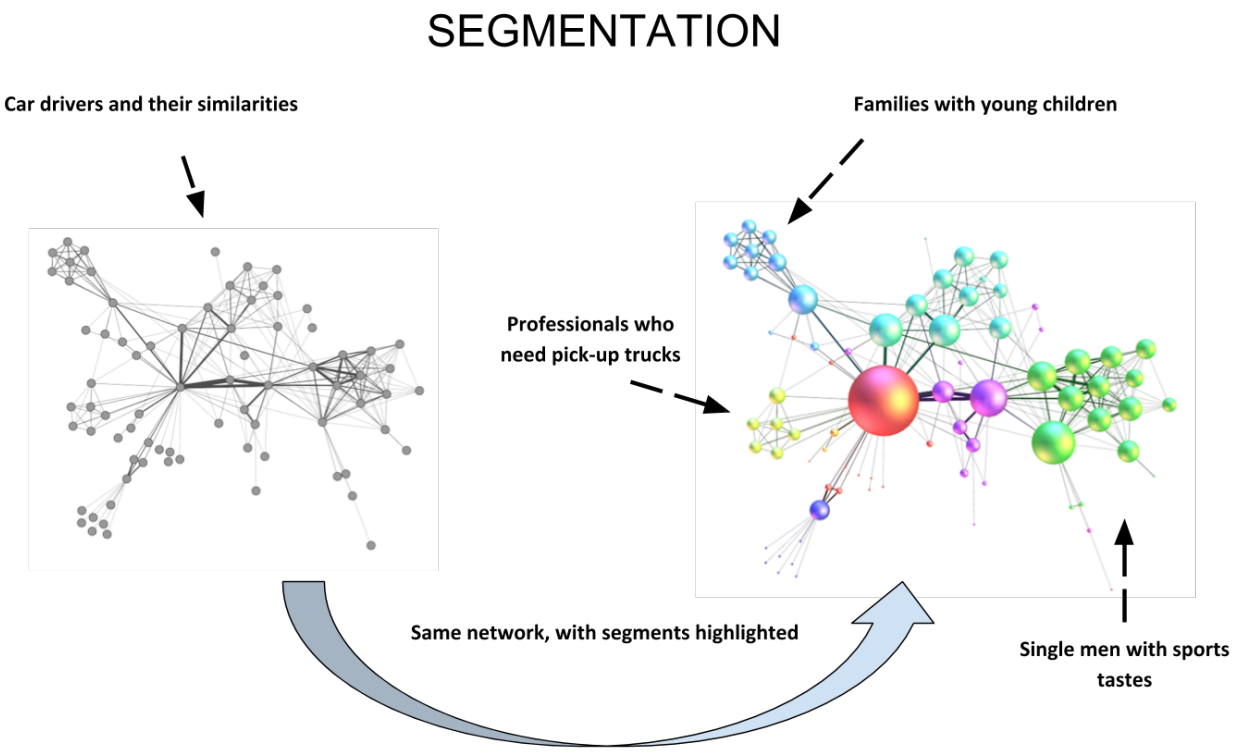


Figure 7. segmentation with community detection in networks

b. Finding key players

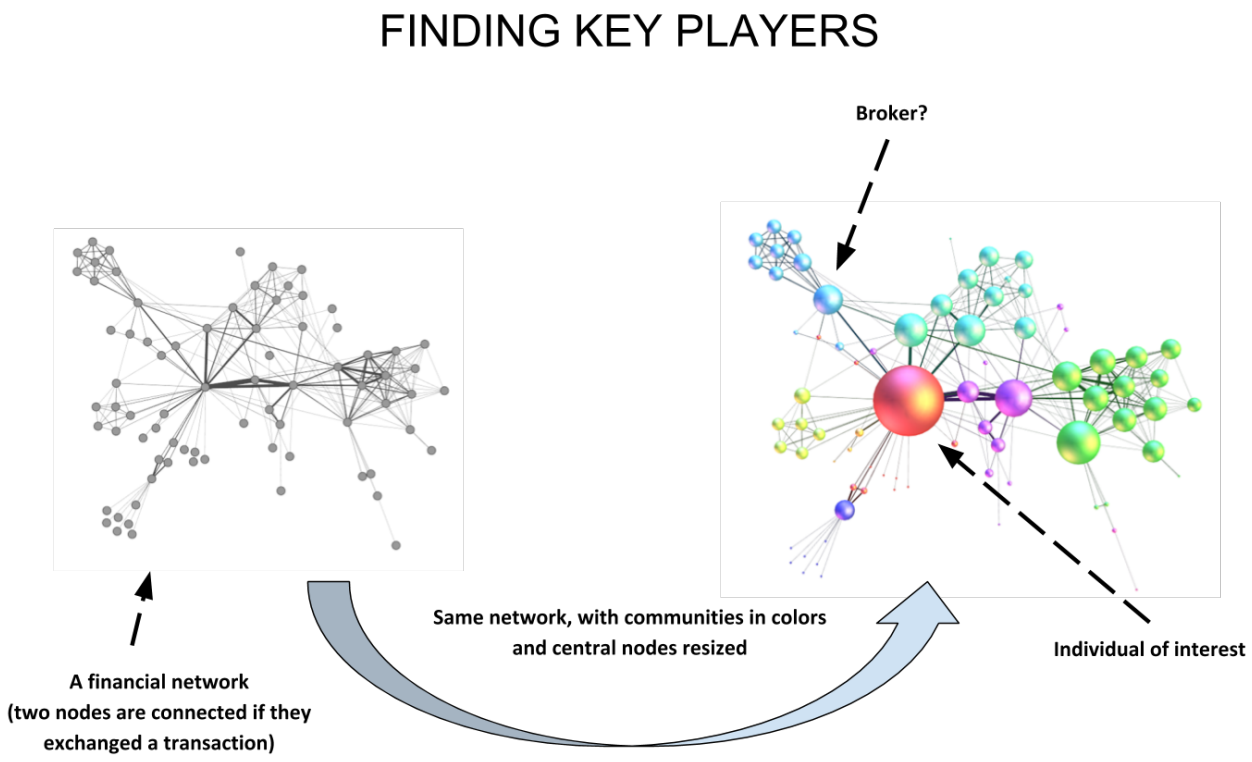


Figure 8. Key players visualized by resizing nodes

c. Understanding how information spreads

A data science company created "Where does my tweet go", which traces how a given tweet spreads through retweets.

The service is now discontinued (Twitter data was too expensive to buy) but the mechanism can be explained:

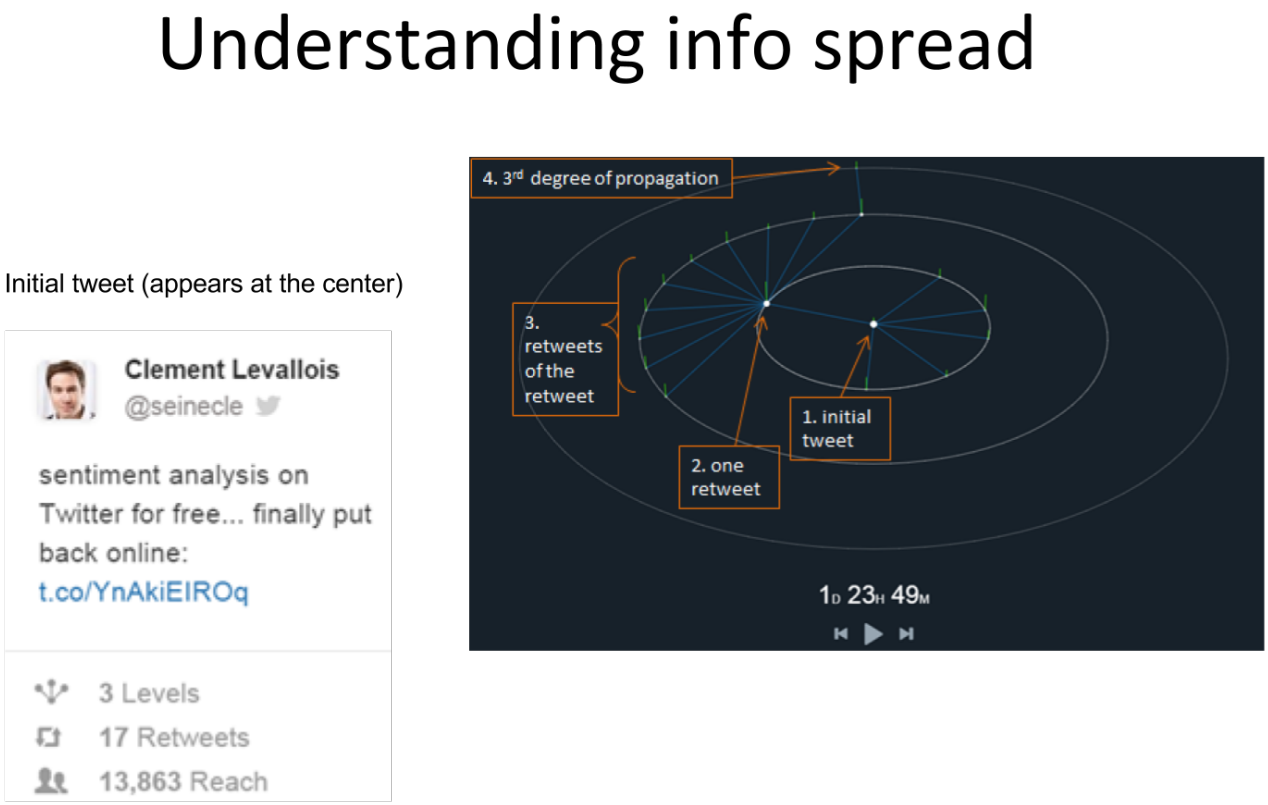


Figure 9. WDMTG by MFGLabs

d. Identifying patterns - for fraud detection, control or intelligence.

In the following video, we see participants in the money market (short term loans between banks) in Europe.

2 banks are connected if one lends to the other. The pattern of exchanges shifts through years - banks withdraw from the market.

▶ https://www.youtube.com/watch?v=YvauCrHGWYc *(YouTube video)*

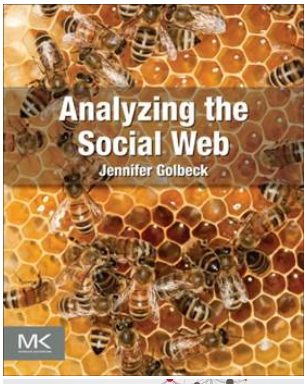
(the full study is available here: https://www.dnb.nl/en/binaries/Working%20Paper%20418_tcm47-305800.pdf)

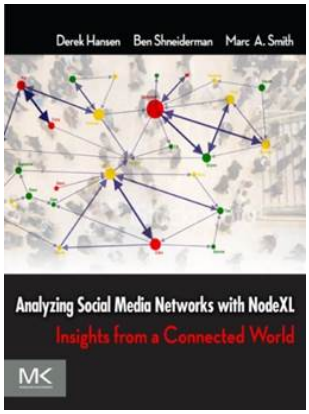
Another example: connecting seemingly unrelated measures of business performance with Oracle BI and Linkurious:

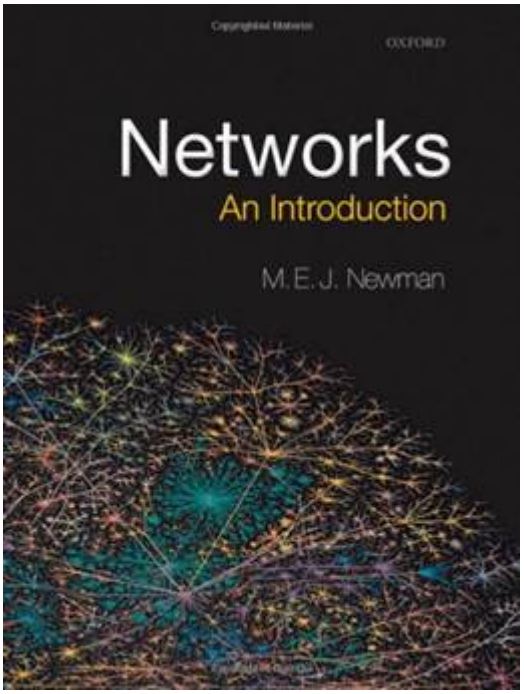
▶ https://www.youtube.com/watch?v=KBIZoUikfwo *(YouTube video)*

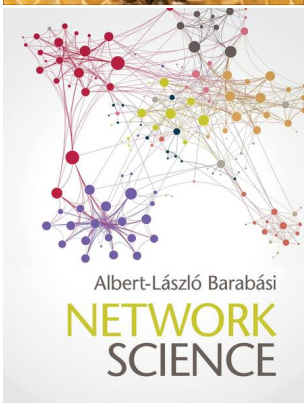
3. To go further

(if viewing from a screen you can click on the covers to get to the Amazon page)









You can also visit my tutorials on Gephi, the leading software to visualize large graphs:

https://seinecle.github.io/gephi-tutorials/

The end

Find references for this lesson, and other lessons, here.

This course is made by Clement Levallois.

Discover my other courses in data / tech for business: http://www.clementlevallois.net

Or get in touch via Twitter: @seinecle