

# Visual Network Analysis and Network Storytelling: Doing Networks other than with Mathematics

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Caution:  
slippery floor!

## Part 1: the great conflation: are we talking about the same networks?

Venturini, T., Munk, A., & Jacomy, M. (2016). *Actor-Network VS Network Analysis VS Digital Networks Are We Talking About the Same Networks?* In D. Ribes & J. Vertesi (Eds.), *DigitalSTS: A Handbook and Fieldguide* (forthcoming).

Venturini, T. (2012). *Great expectations: méthodes quali-quantitative et analyse des réseaux sociaux*. In J.-P. Fourmentaux (Ed.), *L'Ère Post-Media. Humanités digitales et Cultures numériques* (Vol. 104, pp. 39–51). Paris: Hermann.

**Actor-Network Theory (ANT)** explains how material–semiotic networks come together to act as a whole... These networks are transient, existing in a constant making and re-making... relations need to be repeatedly “performed” or the network will dissolve.

[https://en.wikipedia.org/wiki/Social\\_network](https://en.wikipedia.org/wiki/Social_network)

**Social Network Analysis (SNA)** investigates social structures through graph theories. It characterizes structures in terms of nodes (individual actors, people, or things within the network) and the ties or edges (relationships or interactions) that connect them.

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### Digital Networks

The Internet is the global system of interconnected computer networks... It is a network of networks of millions of private, public, academic, business, and government networks.

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The World Wide Web is an information space where documents and other web resources are... interlinked by hypertext links, and can be accessed via the Internet.

[https://en.wikipedia.org/wiki/World\\_Wide\\_Web](https://en.wikipedia.org/wiki/World_Wide_Web)

A few definitions  
(from Wikipedia)

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#### Digital Networks

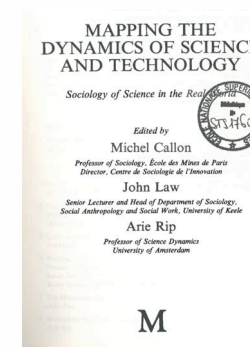
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A few definitions  
(from Wikipedia)

Callon, M., Law, J., & Rip, A. (1986).

*Mapping the Dynamics of Science and Technology*. London: Macmillan.



**Instead of following the actors we may therefore follow the texts.** We may not, in this way, find out everything there is to know about scientists and laboratories. However, the study of texts is well suited to our particular and limited task: that of studying scientific change.

**The force of such texts also resides in the fact that they contain links with other texts (references to the literature), work and institutions...** In sum, texts make possible the construction of linkages between existing entities and the formation of novel entities.

Where the conflation started

1. The theoretical idea that collective phenomena are best described not by their substances, but by their relations (**actor-network theory**).
2. The methodological appeal for new techniques to analyse and represent the connections between social actors (**network analysis**).
3. The intuition that the inscriptions left by collective actions could be re-purposed for social research (**network data**).

Felicitously confounded by the ambiguity of the word 'network'

1. a conceptual topology (the space of connections as opposed to the Euclidian space of coordinates)
2. a set of computation techniques (the mathematics of graphs)
3. an hyper-textual organization of inscriptions (the relational datasets)

### The 3 ingredients of the conflation

a theory without methods  
(actor-network theory)

+

a methods without theory  
(social network analysis)

### A marriage made in heaven

a theory without methods  
(actor-network theory)

+

a methods without theory  
(social network analysis)

+

Once you can get information as bores, bytes, modem, sockets, cables and so on, you have actually a more material way of looking at what happens in Society.

**Virtual Society thus, is not a thing of the future, it's the materialisation, the traceability of Society.** It renders visible because of the obsessive necessity of materialising information into cables.

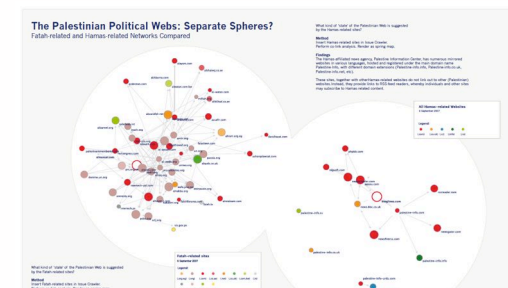
Latour, B. (1998).

Thought experiments in social science: from the social contract to virtual society  
In 1st *Virtual Society?* Annual Public Lecture. Brunel University, London.

...and in earth

Marres, N., & Rogers, R. (2005). Recipe for Tracing the Fate of Issues and their Publics on the Web.  
In L. Bruno & P. Weibel (Eds.), *Making Things Public*. Karlsruhe/Cambridge Mass: ZKM/MIT Press.

We took to the Web to study public debates on science and technology, but we found 'issue-networks' instead... Following hyperlinks among pages dealing with a given issue, we found that these links provided a means to demarcate the network that could be said to be staging the controversy in the new medium

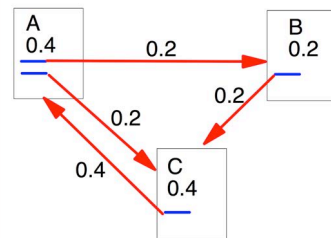


Exploiting the relationality of digital traces for social sciences

Page, L., Brin, S., Rajeev, M., & Terry, W. (1998)

The PageRank Citation Ranking: Bringing Order to the Web.

It is obvious to try to apply standard citation analysis techniques to the web's hypertextual citation structure. One can simply think of every link as being like an academic citation (p.2)



The PageRank Citation Ranking:  
Bringing Order to the Web

January 29, 1998

And the other way around

a theory without methods  
(actor-network theory)

a methods without theory  
(social network analysis)



the major technological and economic innovation of the century  
(digital networks)

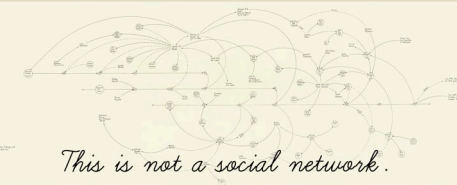
From conflation comes power  
(and responsibility)

1. Partiality of digital inscriptions
2. (Lack of) Heterogeneity of nodes and edges
3. (Lack of) Reversibility of nodes and networks
4. Dynamics of relational change

Yet networks are not networks



*Ceci n'est pas une pipe.*



*This is not a social network.*



*This is not a digital network.*

Latour, B. (2003). On using ANT for studying information systems: a (somewhat) Socratic dialogue. In C. Avgerou, C. Ciborra, & F. F. Land (Eds.), *The Social Study of Information and Communication Study* (pp. 62–76). Oxford: University Press.

Professor — you should not confuse the network that is drawn by the description and the network that is used to make the description.

Student — ...?

Professor — But yes! Surely you'd agree that drawing with a pencil is not the same thing as drawing the shape of a pencil. It's the same with this ambiguous word, network...

Being connected, being interconnected, being heterogeneous, is not enough. It all depends on the sort of action that is flowing from one to the other, hence the words 'net' and 'work'. Really, we should say 'worknet' instead of 'network'. It's the work, and the movement, and the flow, and the changes that should be stressed. But now we are stuck with 'network' and everyone thinks we mean the World Wide Web or something like that.

Yet networks are not networks

Munster, A. (2013). *An Aesthesis of Networks*. Cambridge Mass.: MIT Press

#### An Aesthesis of Networks

Conjunctive Experience in Art and Technology



Anna Munster



A diagram of a network, then, does not look like a network but maintain the same qualities of relations – proximities, degrees of separation, and so forth – that a network also requires in order to form.

Resemblance should here be considered a resonating (p. 24).

Resonance not resemblance

## Part 2: what do we see when we look at networks?

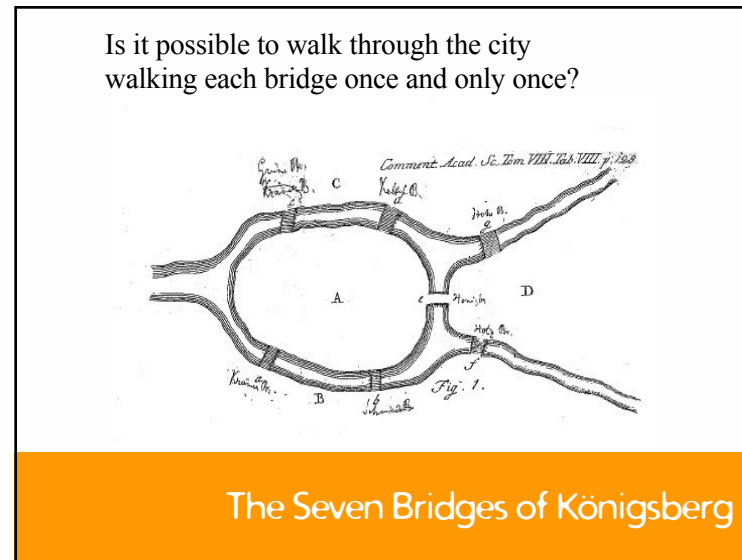
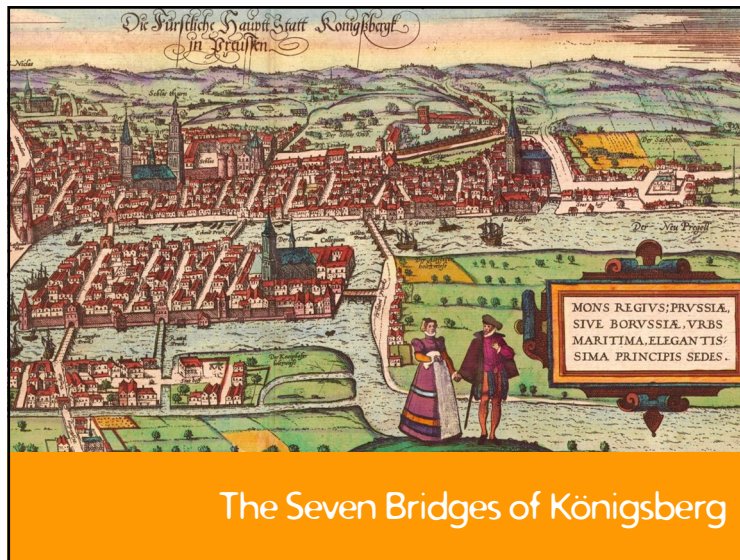
Venturini, T., Jacomy, M., & Jensen, P. (work in progress).

What do we See, When we Look At Networks. Towards a Measure of Cluster Legibility for Force-Driven Network Layouts

1. Success of graph mathematics
2. Mistrust of visual ambiguity &  
Focus on paths rather than density

Why are we ignoring the questions





Euler, 1736, Solutio problematis ad geometriam situs pertinentis

	16
A* - 8	4
B* - 4	2
C* - 4	2
D - 3	2
E - 5	3
F* - 6	3
	16

Hoc porro modo si operatio ad finem perducatur, multa inveniuntur, quae non erant in quaestione; in quo procul dubio tantae difficultatis causa consistit. §3

If, in this way, the work could be brought to a conclusion, many irrelevant factors would arise; therein without doubt lies the reason for the difficulty

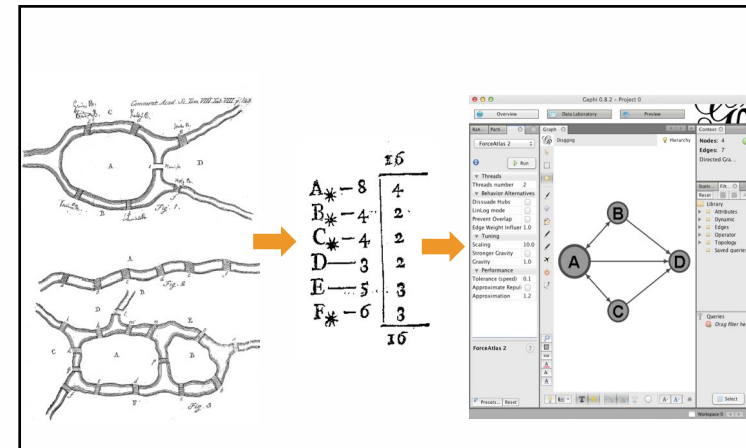
(translation in Fleischner, H. 1990. Eulerian Graphs and Related Topics. Amsterdam: Elsevier)

From map to math ...

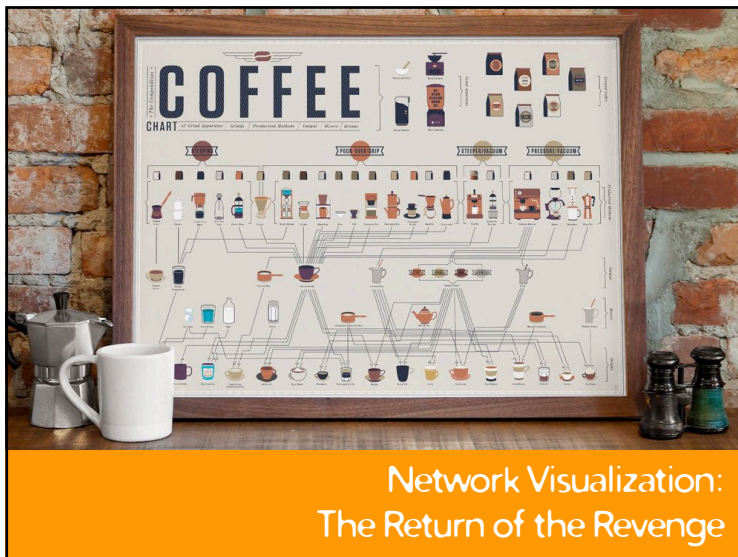




A mighty mathematics



... from graph to graphic

Network Visualization:  
The Return of the Revenge

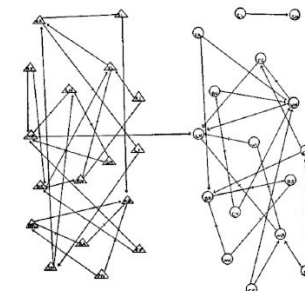
Moreno, J. (1934). Who Shall Survive? Washington, DC: Nervous and Mental Disease Publishing

The forms taken by the interrelation of individuals is a structure and the complete pattern of these structures within a group is its organization. The expression of an individual position can be better visualized through a sociogram than through a sociometric equation (Moreno, 1934, p. 103)

Jacob L. Moreno, April 3, 1933, The New York Times

## EMOTIONS MAPPED BY NEW GEOGRAPHY

Charts Seek to Portray the  
Psychological Currents of  
Human Relationships.

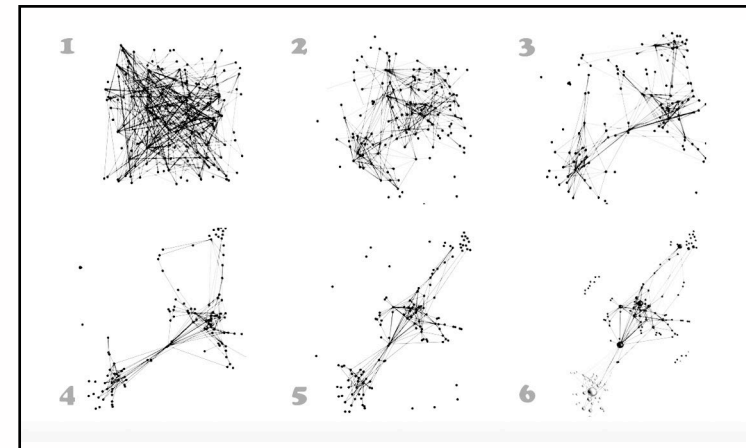


Networks as maps

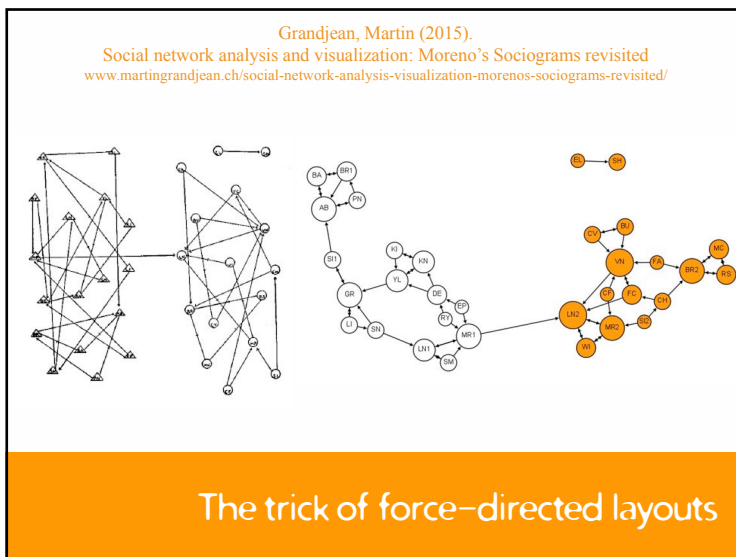




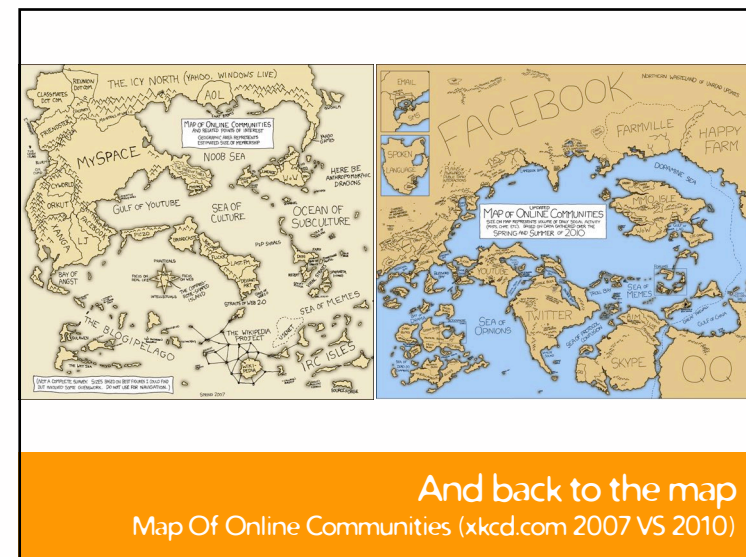
Force-Directed Spatialisation



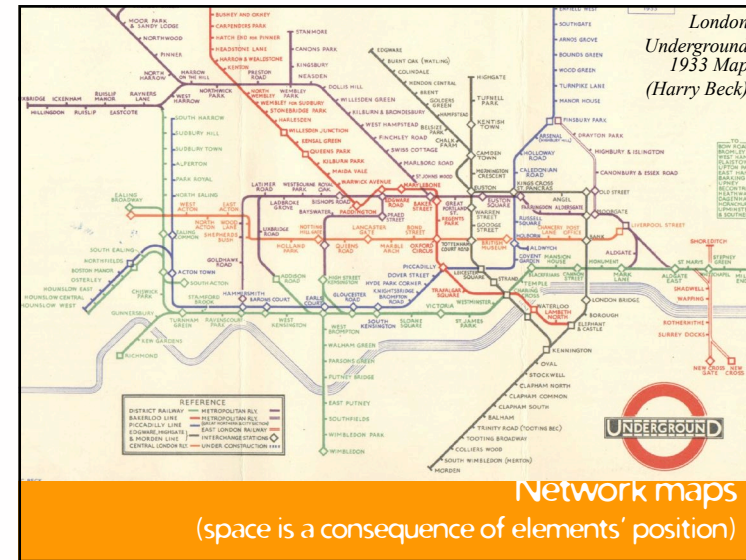
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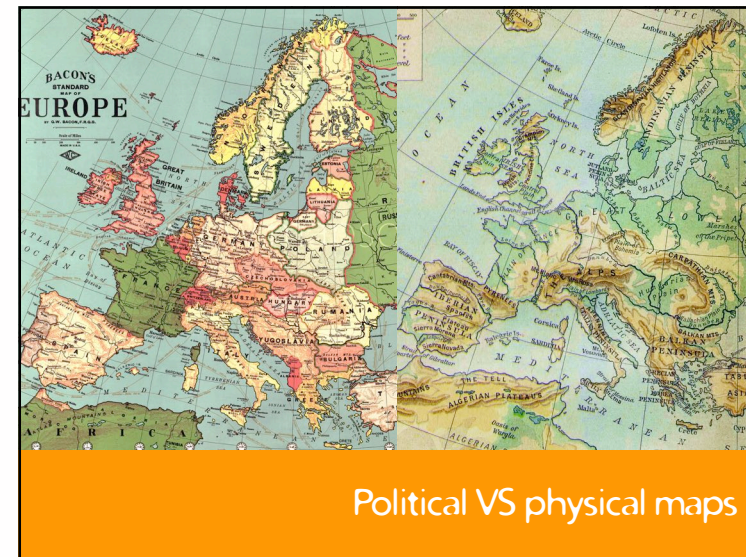
The trick of force-directed layouts

And back to the map  
Map Of Online Communities (xkcd.com 2007 VS 2010)

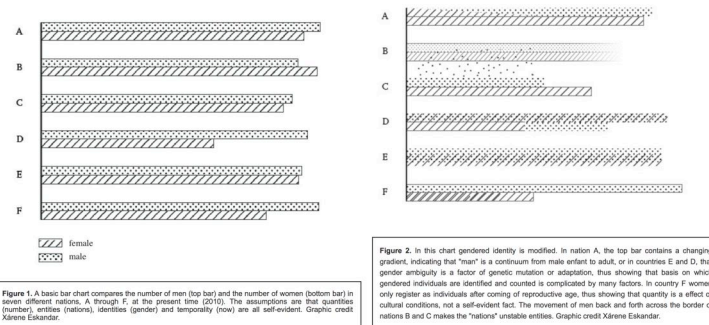




1. Success of graph mathematics
2. Mistrust of visual ambiguity &  
Focus on paths rather than density



Drucker, J. (2011). *Humanities Approaches to Graphical Display*.  
*Digital Humanities Quarterly*, 5(1), 1–20.

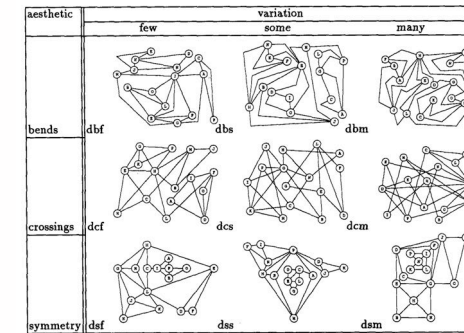


On the Value of Ambiguity

Purchase, H. C., Cohen, R. F., & James, M. (1996).  
*Validating Graph Drawing Aesthetics*  
 In *Graph Drawing* (pp. 435–446). Berlin: Springer

"the fewer the  
 number of lines  
 crossing, the better  
 the sociogram"

Moreno, J. (1934).  
*Who Shall Survive?*



Network reading as following paths

Gibson, H., Faith, J., & Vickers, P. (2013). A survey of two-dimensional graph layout techniques for information visualisation. *Information Visualization*, 12(3–4), 324–357.

What is interesting though is the type of tasks she asked her users to complete. These were finding shortest paths, identifying nodes to remove in order to disconnect the graph and identifying edges to remove in order to disconnect the graph (p. 27)

Network reading as feeling density

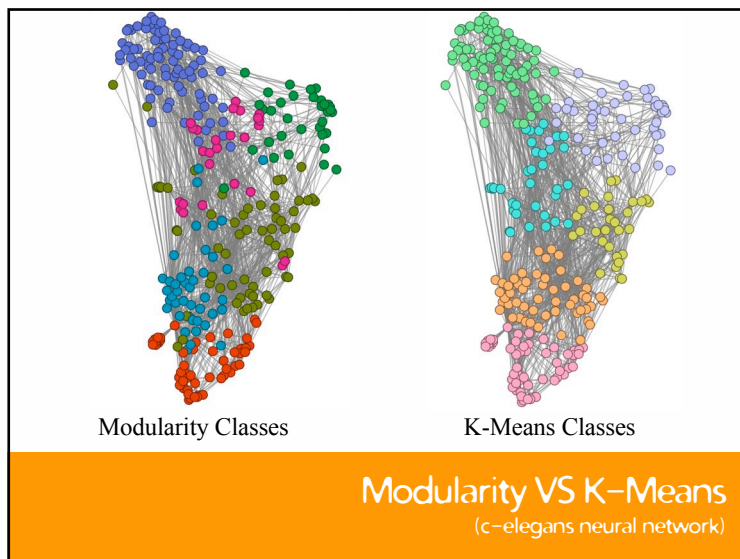
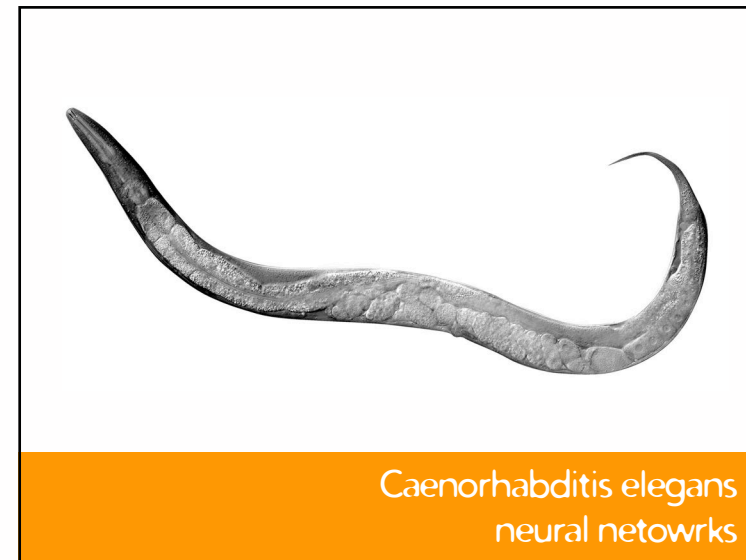
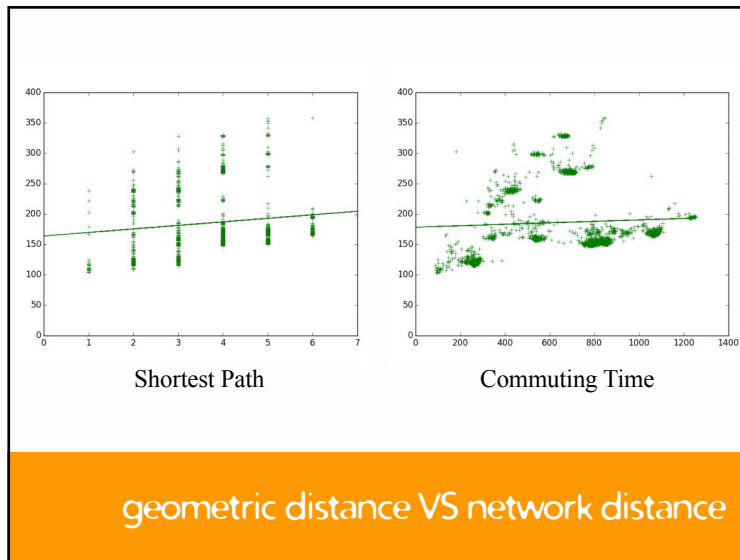
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It is unclear as to if these type of accurate, precise measurements are a typical analysis tasks for graphs with hundreds or thousands of nodes ... If those kinds of tasks become infeasible due to the volume of nodes and edges then the better layouts should support the user for a different set of tasks ...

Users tried to optimise clustering ahead of any other aesthetic metric also indicating users are more concerned with overall structure. Another aim for layout should then be to support users in tasks concerned with overview, structure, exploration, patterns and outliers (p. 28)

Network reading as feeling density



## Part 3: Visual and narrative networks analysis

Venturini, T., Jacomy, M., Bounegru, L., & Gray, J. (2018). *Visual Network Exploration for Data Journalists*. In S. I. Eldridge & B. Franklin (Eds.), *The Routledge Handbook to Developments in Digital Journalism Studies* (forthcoming). Abingdon: Routledge.

Venturini, T., Jacomy, M., & Carvalho Pereira, D. (2015). *Visual Network Analysis*. Paris. *Sciences Po médialab working paper*.

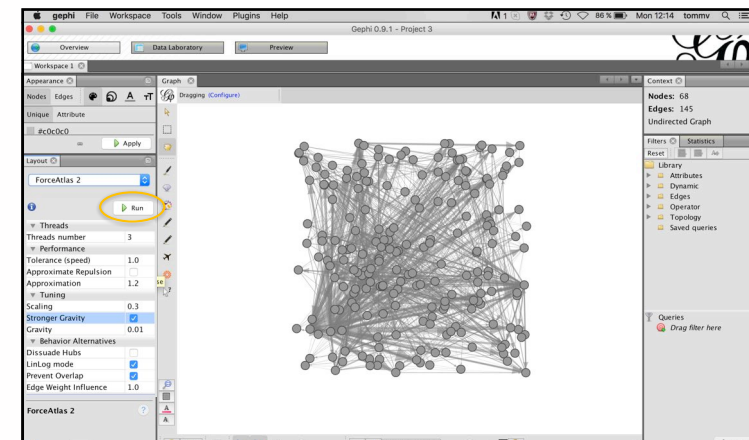
Venturini, T., Bounegru, L., Jacomy, M., & Gray, J. (2016). *How to Tell Stories with Networks: Exploring the Narrative Affordances of Graphs with the Iliad*. In M. T. Schäfer & K. van Es (eds.), *Datafied Society*. Amsterdam: University Press.

1. Nodes position → clusters, centres & bridges
2. Nodes size → authorities & hubs
3. Nodes colour → categories

Visual Network Analysis

1. Nodes position → clusters, centres & bridges
2. Nodes size → authorities & hubs
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Visual Network Analysis



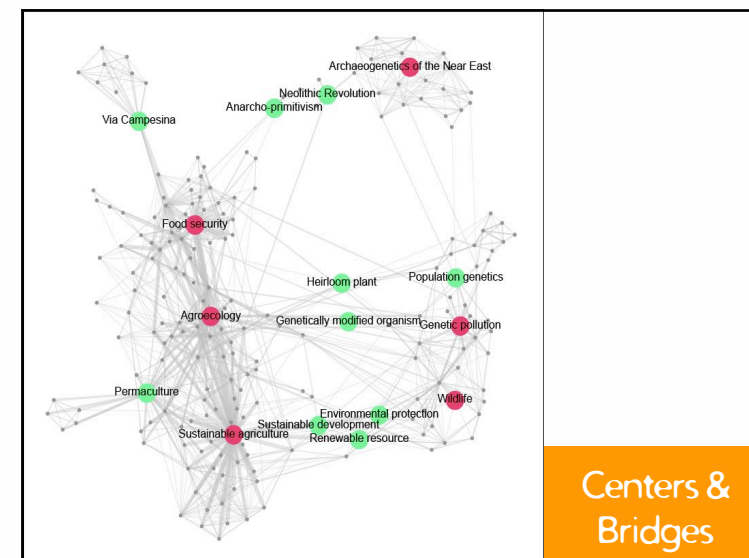
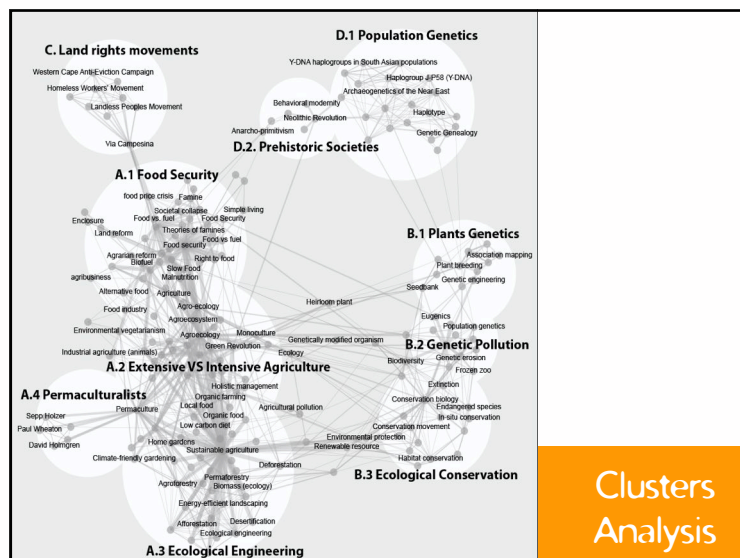
Node position  
Spatialize with ForceAtlas 2



**ForceAtlas 2 parameters**  
(to balance clustering & spacing)

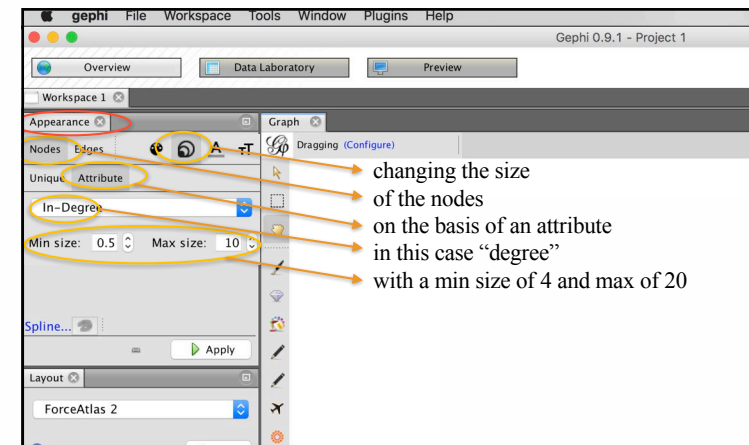
- Threads:** Threads number: 3
- Performance:** Tolerance (speed): 1.0 (Increase (and approximate) to speed up spatialisation; Reduce if network oscillates); Approximate Repulsion: [checkbox]; Approximation: 1.2
- Tuning:** Scaling: 0.3 (Enlarges/shrinks network (like zoom, but without nodes size)); Stronger Gravity: [checked] (Pulls all nodes toward the center (use for disconnected); Stronger gravity is exponential); Gravity: 0.01
- Behavior Alternatives:** Dissuade Hubs: [checkbox]; LinLog mode: [checked] (Enlarge structural holes (demands reducing scaling)); Prevent Overlap: [checked] (Avoid nodes overlapping); Edge Weight Influence: 1.0 (Increase/decrease differences in edge attraction force)

**Node position**  
Spatialize with ForceAtlas 2

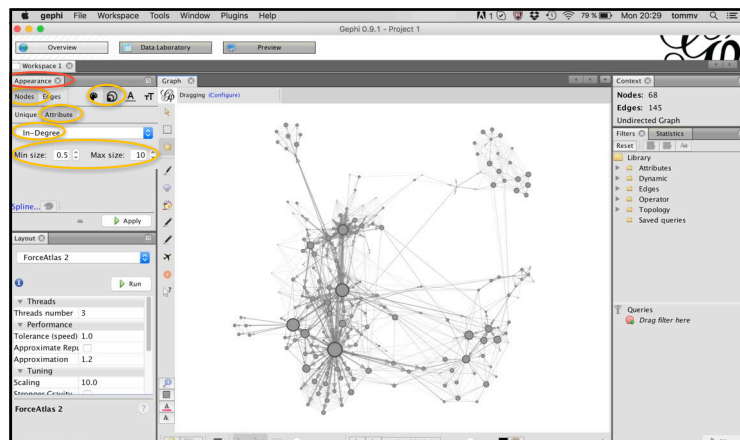


1. Nodes position → clusters, centres & bridges
2. Nodes size → authorities & hubs
3. Nodes colour → categories

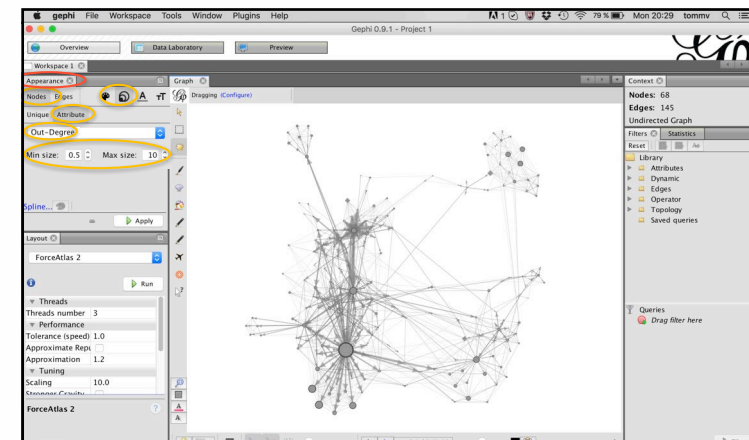
## Visual Network Analysis



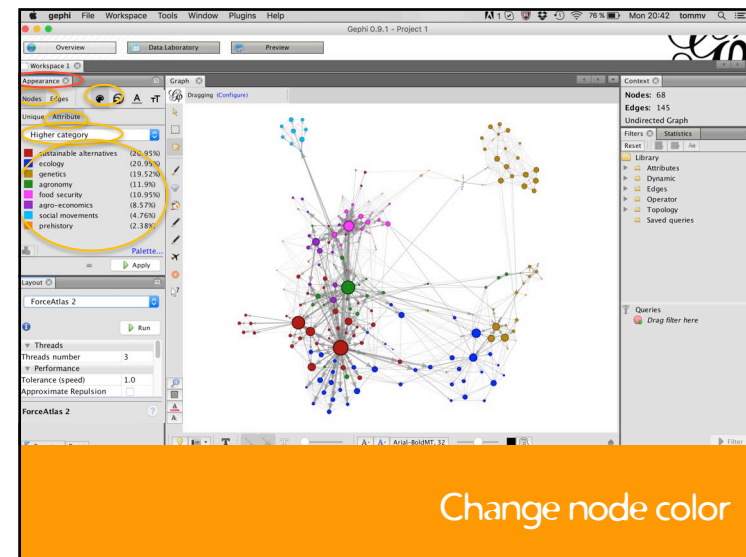
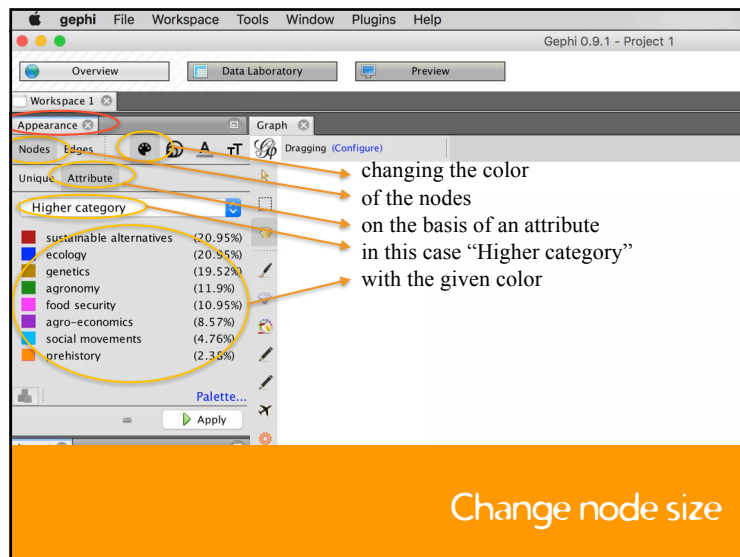
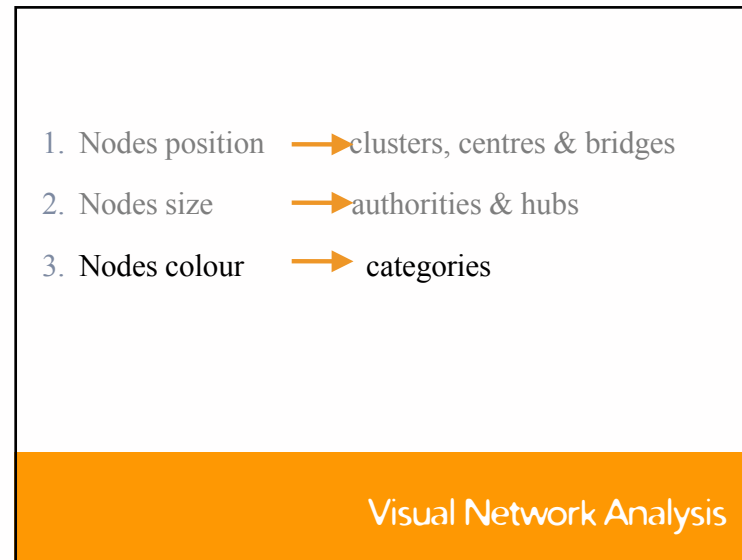
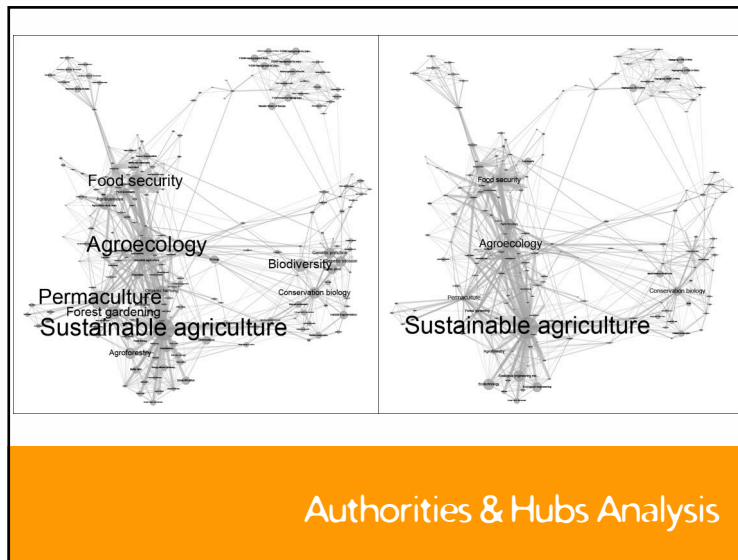
## Change node size

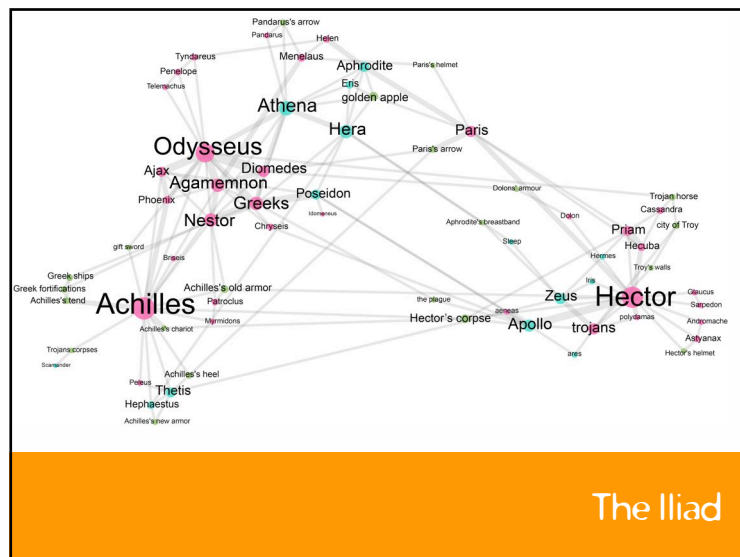
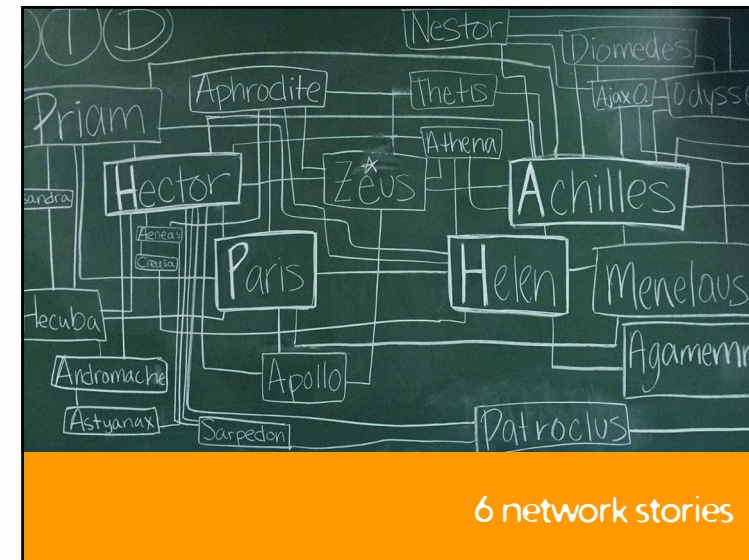
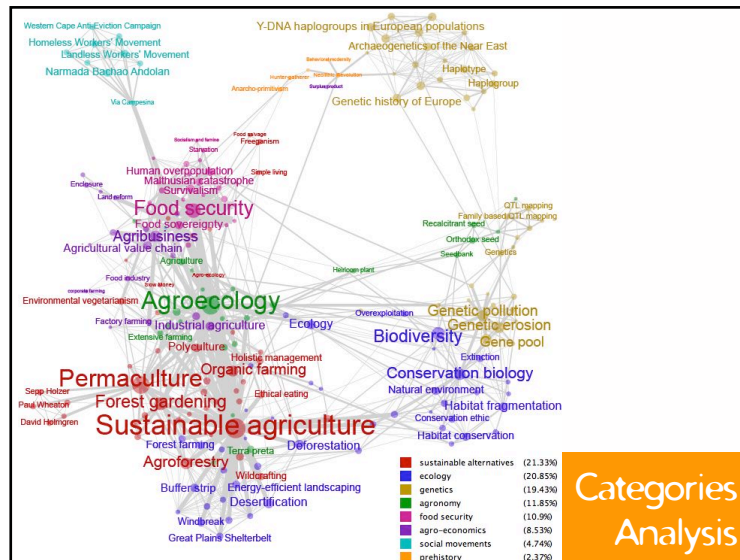


## Change node size



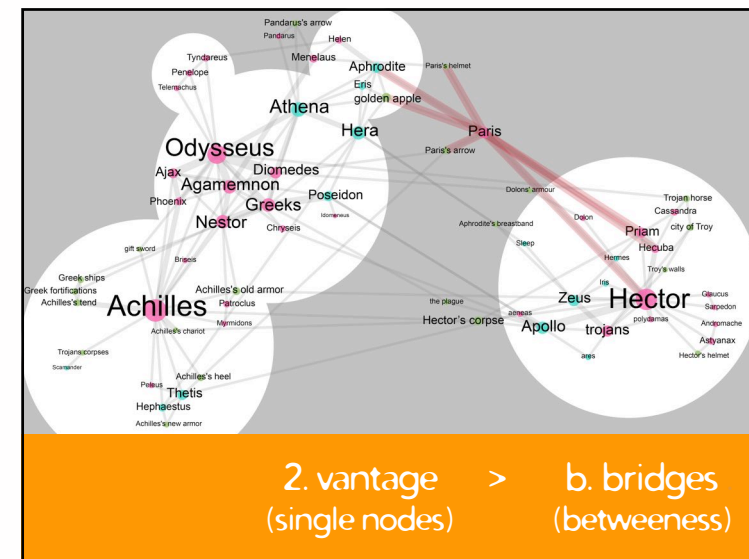
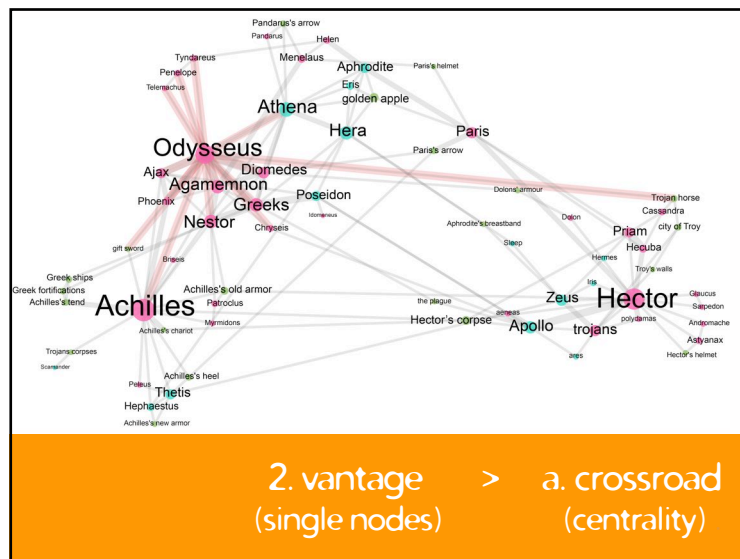
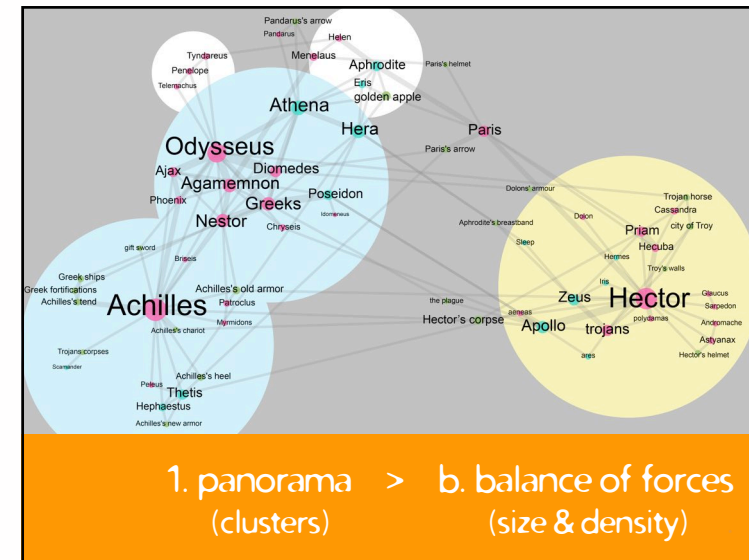
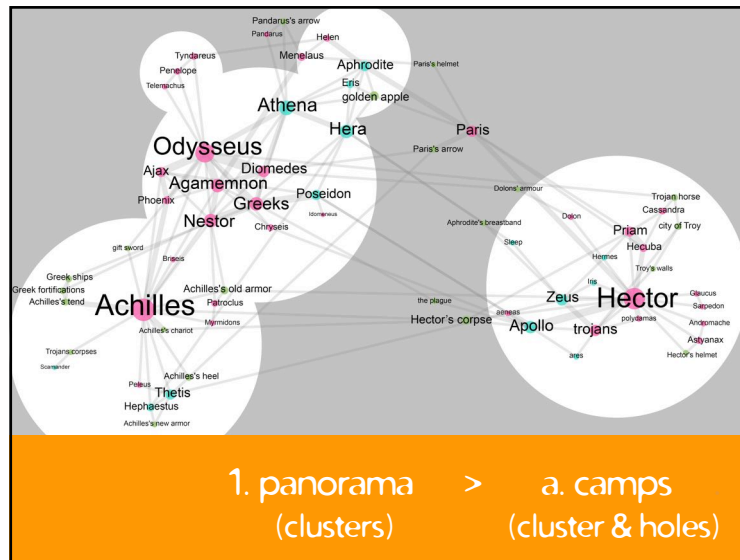
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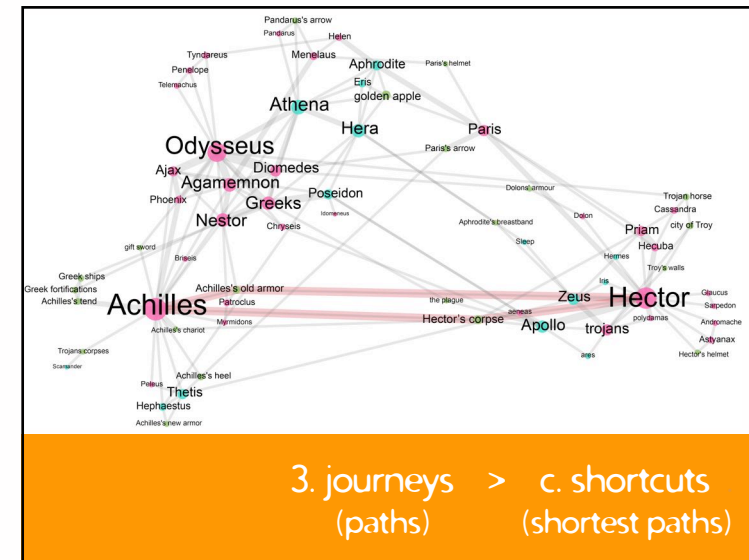
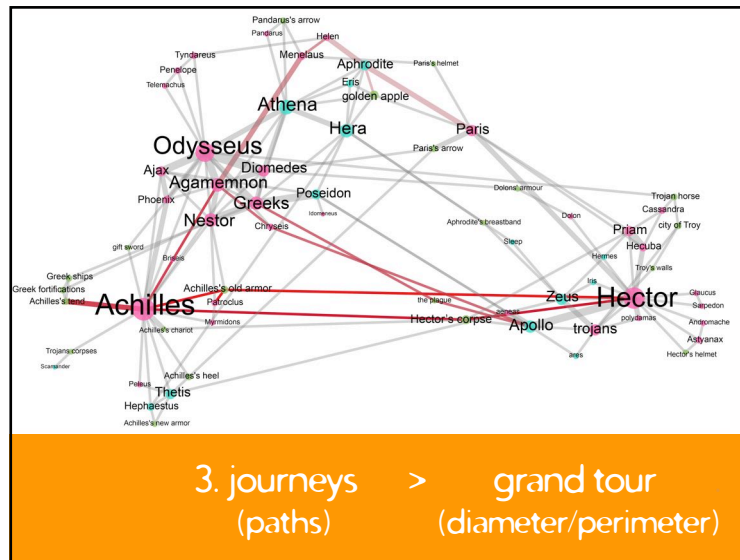




1. The panorama (clusters)
    - a) The camps (clusters & holes)
    - b) The (un)balance of forces (size & density)
  2. The vantage (single nodes)
    - a) The crossroad (centrality)
    - b) The the bridge (betweenness)
  3. The journeys (paths)
    - a) The grand tour (diameter / perimeter)
    - b) The shortcut (shortest path)
- 6 network stories**







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