

Comparison of Curricular Contents and Structures Across Network Science ~~Graduate~~ Courses

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NetSci Courses Everywhere!

The screenshot shows a web browser window with the URL [https://www.complexityexplorer.org/explore/syllabi?utf8=&explore_syllabus_collection\[order\]=1](https://www.complexityexplorer.org/explore/syllabi?utf8=&explore_syllabus_collection[order]=1). The page features a navigation bar with links for **EXPLORE:** Glossary, Resources, **Course Syllabi**, Get Involved, and Volunteer to Subtitle Videos, along with a button to **+ Submit a course syllabus**. Below the navigation bar, the page indicates it is browsing by **Title** and showing **22 syllabi**. A search bar for course syllabi and an advanced search option are also present. A horizontal menu lists letters from A to Z, with **T** highlighted. The main content area displays a list of course titles, years, and instructors:

- Advanced Topics in Network Science**, 2016, Hiroki Sayama, Binghamton University, SUNY
- Complex Biological Networks**, 2014, Elhanan Borenstein, University of Washington
- Complex Networks**, 2014, Peter Dodds, University of Vermont
- Complex Networks**, 2014, Mehmet Gunes, University of Nevada, Reno
- Complex Networks**, 2015, F. Schweitzer, I. Scholtes, Swiss Federal Institute of Technology in Zurich
- Complex Networks**, 2016, Márton Karsai, Eric Fleury, Yannick Leo, École Normale Supérieure de Lyon
- Complex Networks & Systems Seminar I**, 2016, Luis Rocha, Indiana University
- Complex Networks and Enterprises**, 2013, Rahul Basole, Georgia Institute of Technology
- Complex systems: networks and self-organization in biology**, 2013, Anna Dornhaus, University of Arizona
- Introduction to Network Science**, 2015, Filippo Menczer, Indiana University
- Network Theory**, 2015, Mark Newmann, University of Michigan
- Network Theory and Applications**, 2014, Raissa D'Souza, University of California, Davis
- Networks**, 2013, Jon Kleinberg, Eva Tardos, Cornell University

Objective

- Collect and organize information about existing NetSci courses
- Generate a “map” of current NetSci curricular structures
- Identify agreed-upon curricular modules and topic sequences
- Check correspondence with “Network Literacy”

Primary Sources

- <https://www.complexityexplorer.org/>
- <https://github.com/briatte/awesome-network-analysis>
- **Excluded from analysis:**
 - Mathematical graph theory courses
 - Statistics courses
 - Courses in specific domains (e.g., politics, genomics)
 - Special topics/seminar courses
 - Courses with no contents/syllabus available

30 Courses

1. <http://barabasi.com/book/network-science>
2. <http://bingweb.binghamton.edu/~sayama/SSIE641/>
3. <http://faculty.nps.edu/rgera/MA4404.html>
4. <http://hornacek.coa.edu/dave/Teaching/Networks.11/>
5. <http://mae.engr.ucdavis.edu/dsouza/mae298>
6. <http://networksatharvard.com/>
7. <http://ocw.mit.edu/courses/economics/14-15j-networks-fall-2009/>
8. <http://ocw.mit.edu/courses/media-arts-and-sciences/mas-961-networks-complexity-and-its-applications-spring-2011/>
9. http://perso.ens-lyon.fr/marton.karsai/Marton_Karsai/complexnet.html
10. <https://cns.ceu.edu/node/31544>
11. <https://cns.ceu.edu/node/31545>
12. <https://cns.ceu.edu/node/38501>
13. https://courses.cit.cornell.edu/info2040_2015fa/
14. <https://iu.instructure.com/courses/1491418/assignments/syllabus>
15. <https://sites.google.com/a/yale.edu/462-562-graphs-and-networks/>
16. <https://www0.maths.ox.ac.uk/courses/course/28833/synopsis>
17. <https://www.coursera.org/course/sna>
18. <https://www.sg.ethz.ch/media/medialibrary/2014/11/syllabus-cn15.pdf>
19. <http://tuvalu.santafe.edu/~aaronc/courses/5352/>
20. <http://web.stanford.edu/class/cs224w/handouts.html>
21. <http://web.stanford.edu/~jugander/mse334/>
22. http://www2.warwick.ac.uk/fac/cross_fac/complexity/study/msc_and_phd/co901/
23. <http://www.ait-budapest.com/structure-and-dynamics-of-complex-networks>
24. http://www.cabdyn.ox.ac.uk/Network%20Courses/SNA_Handbook%202013-14.pdf
25. <http://www.cc.gatech.edu/~dovrolis/Courses/NetSci/>
26. <http://www.columbia.edu/itc/sociology/watts/w3233/>
27. <http://www.cse.unr.edu/~mgunes/cs765/>
28. <http://www-personal.umich.edu/~mejn/courses/2015/cscs535/index.html>
29. <http://www.stanford.edu/~jacksonm/291syllabus.pdf>
30. <http://www.uvm.edu/~pdodds/teaching/courses/2016-01UVM-303/>

Methods

1. Course schedule/sequence of topics was extracted from each course website
2. Multiple topics covered in a single lecture (if any) were mutually connected to form a clique
3. Topics covered in the following lecture were connected from topics in the previous lecture
4. Some topics were merged together (at my own discretion)

→ Weighted directed network of topics

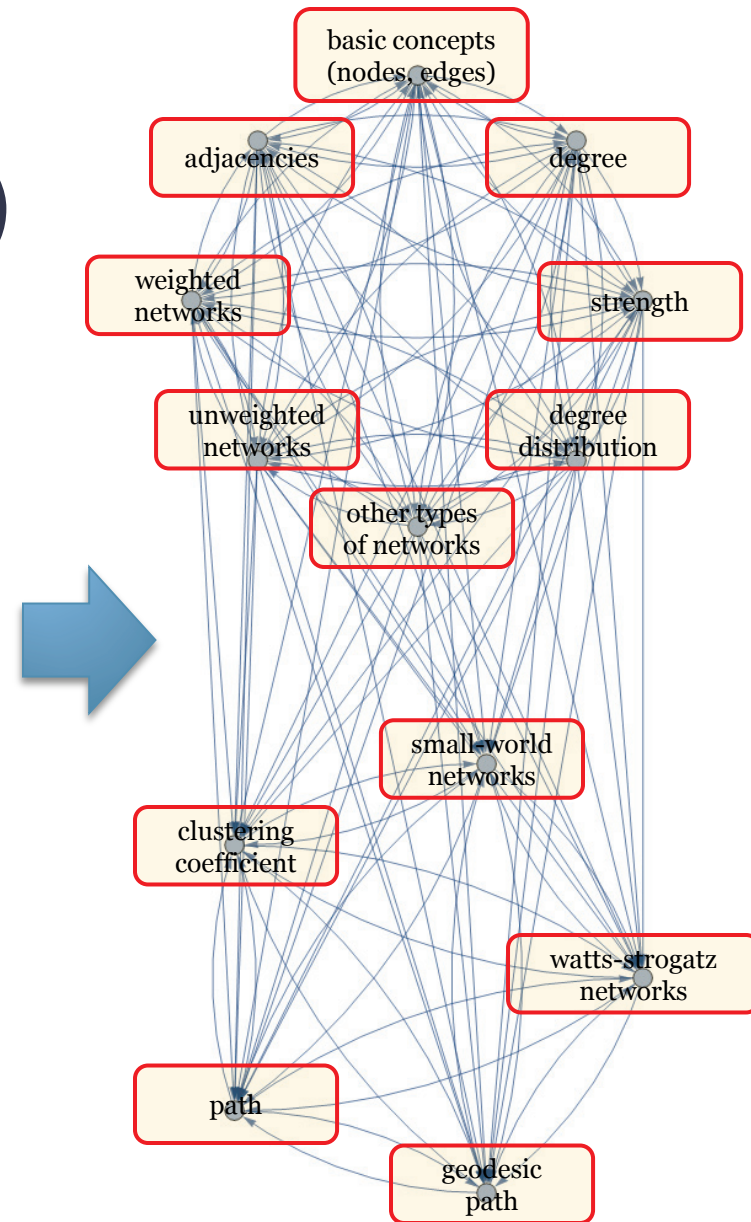
Example (from Mason Porter's)

Synopsis

1. Introduction and Basic Concepts (1-2 lectures): nodes, edges, adjacencies, weighted networks, unweighted networks, degree and strength, degree distribution, other types of networks

2. Small Worlds (2 lectures): clustering coefficients, paths and geodesic paths, Watts-Strogatz networks [focus is on modelling and heuristic calculations]

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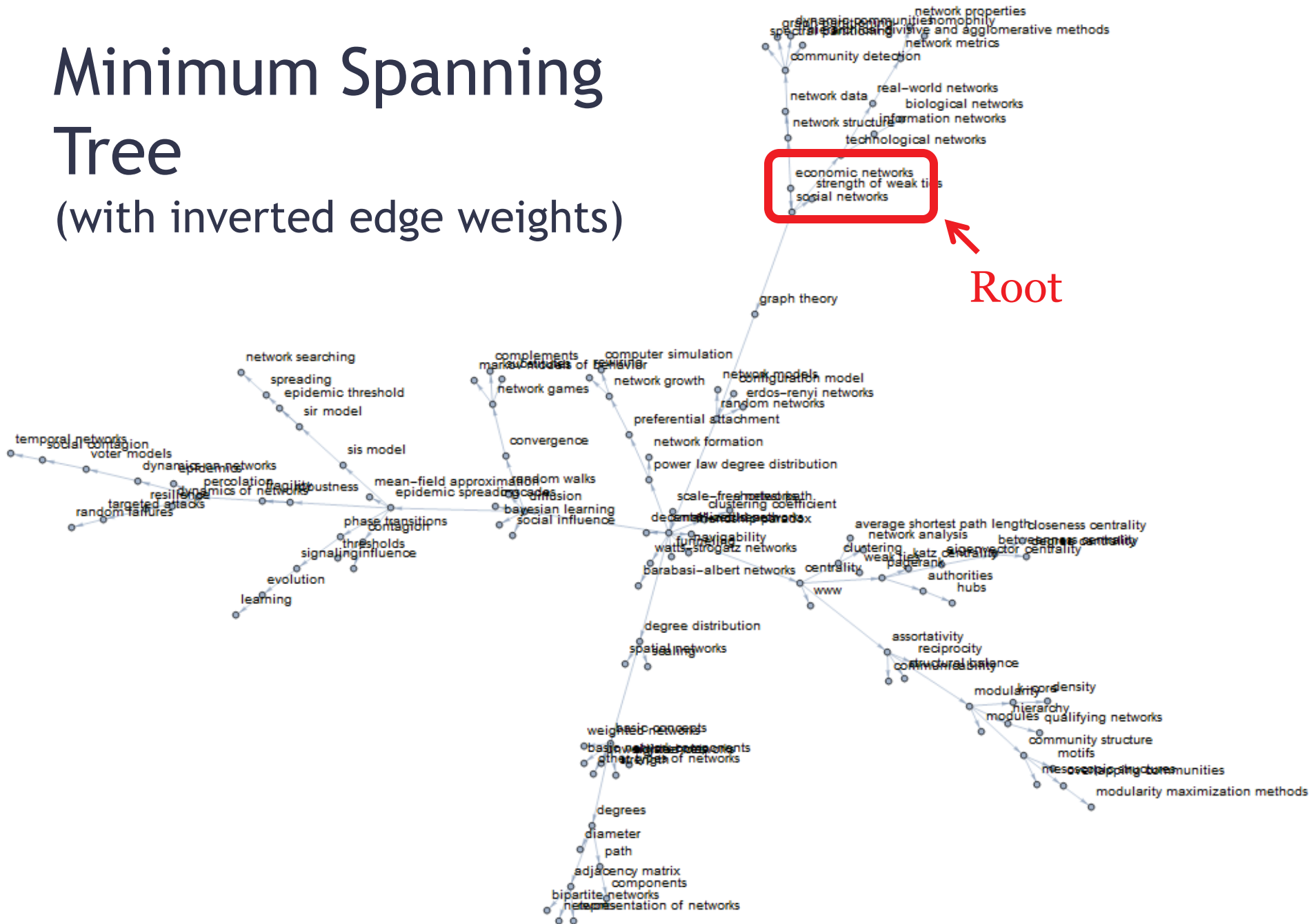


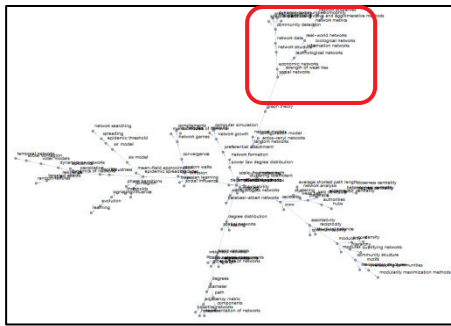
Analysis

- Topic frequencies
- Spanning trees
- Communities

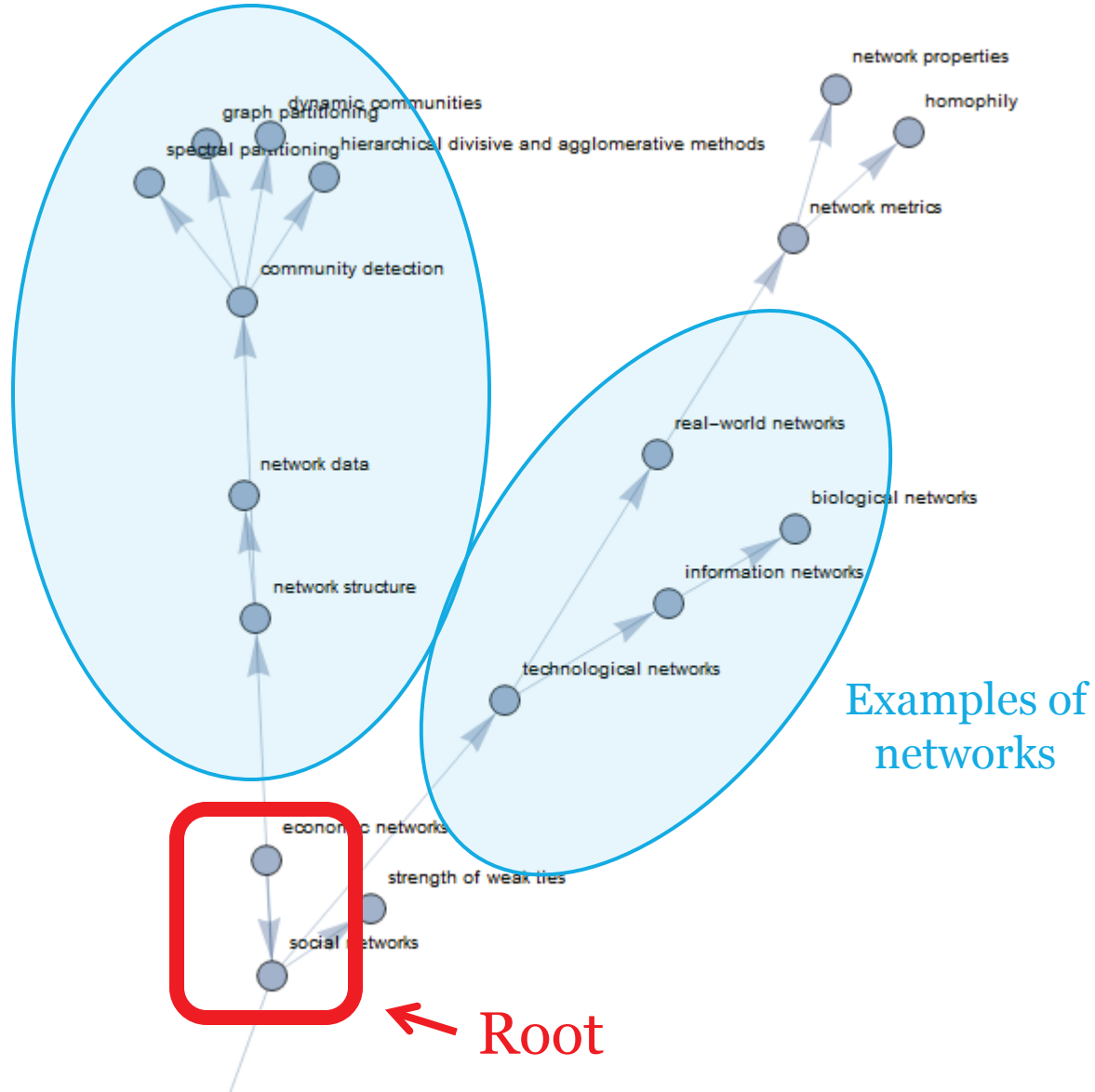
Minimum Spanning Tree

(with inverted edge weights)

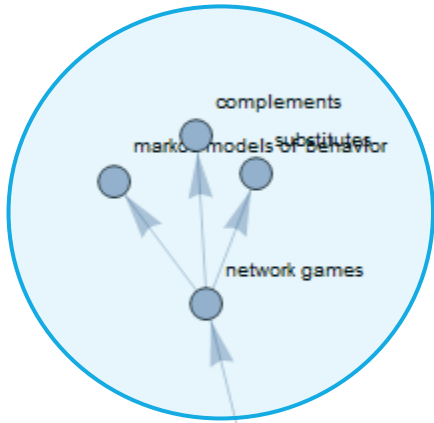




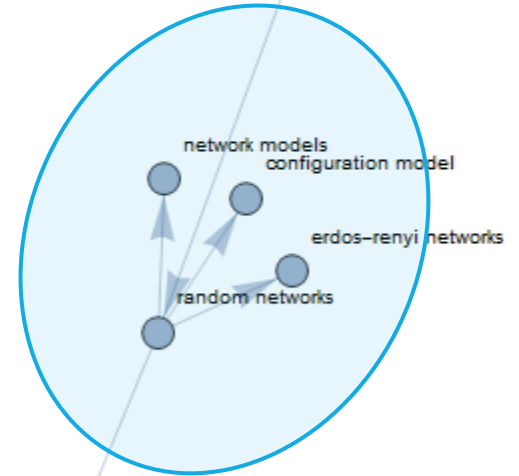
Network data analysis



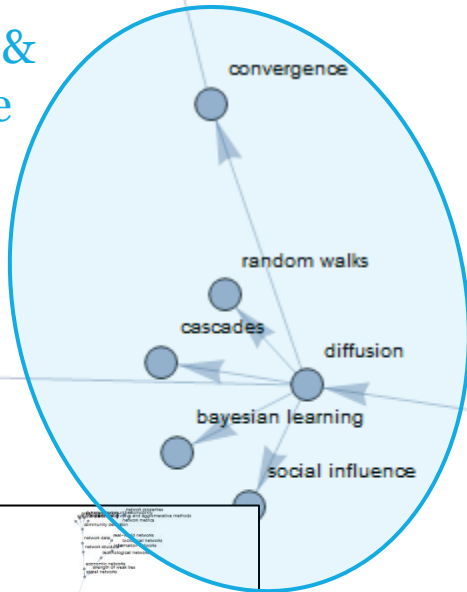
Network games



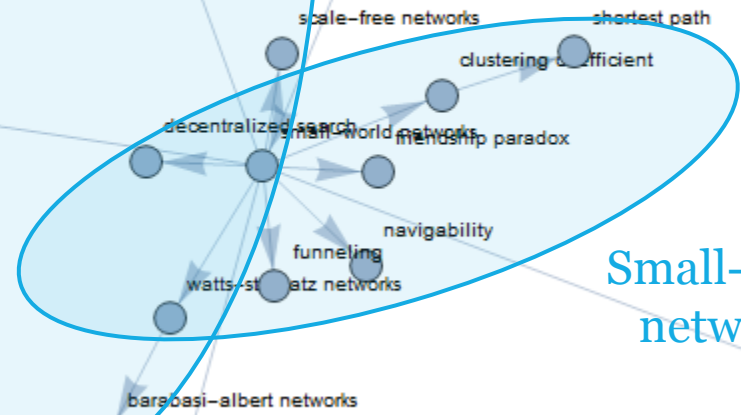
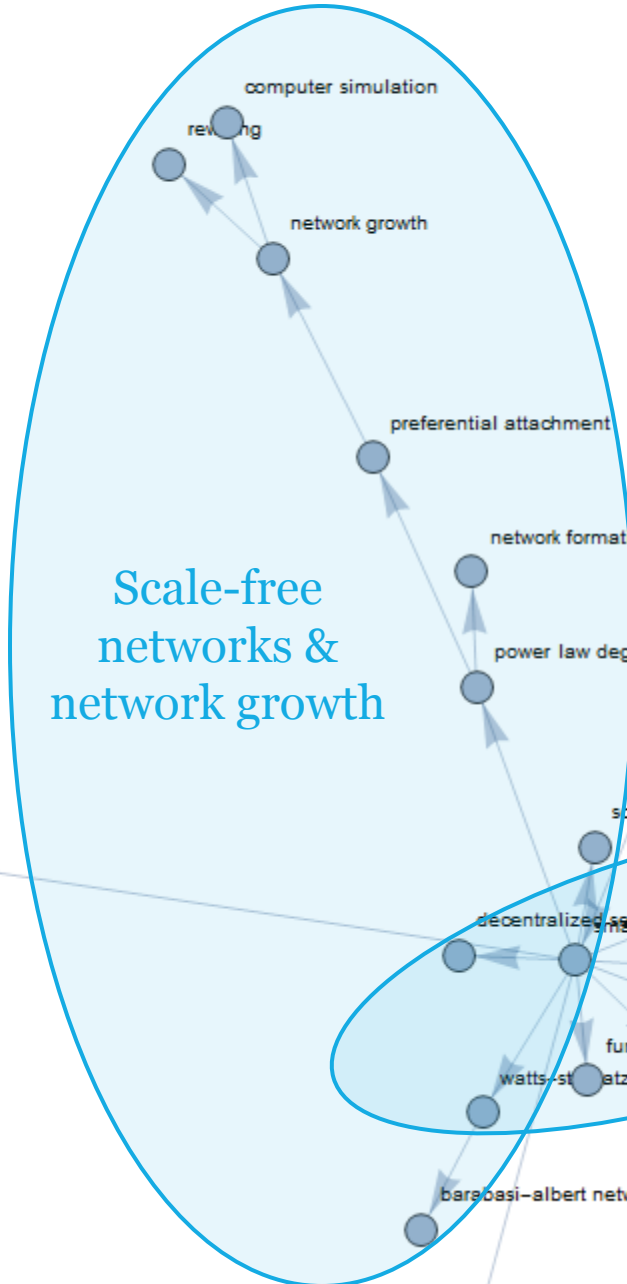
Random networks



Diffusion & influence



Scale-free networks & network growth

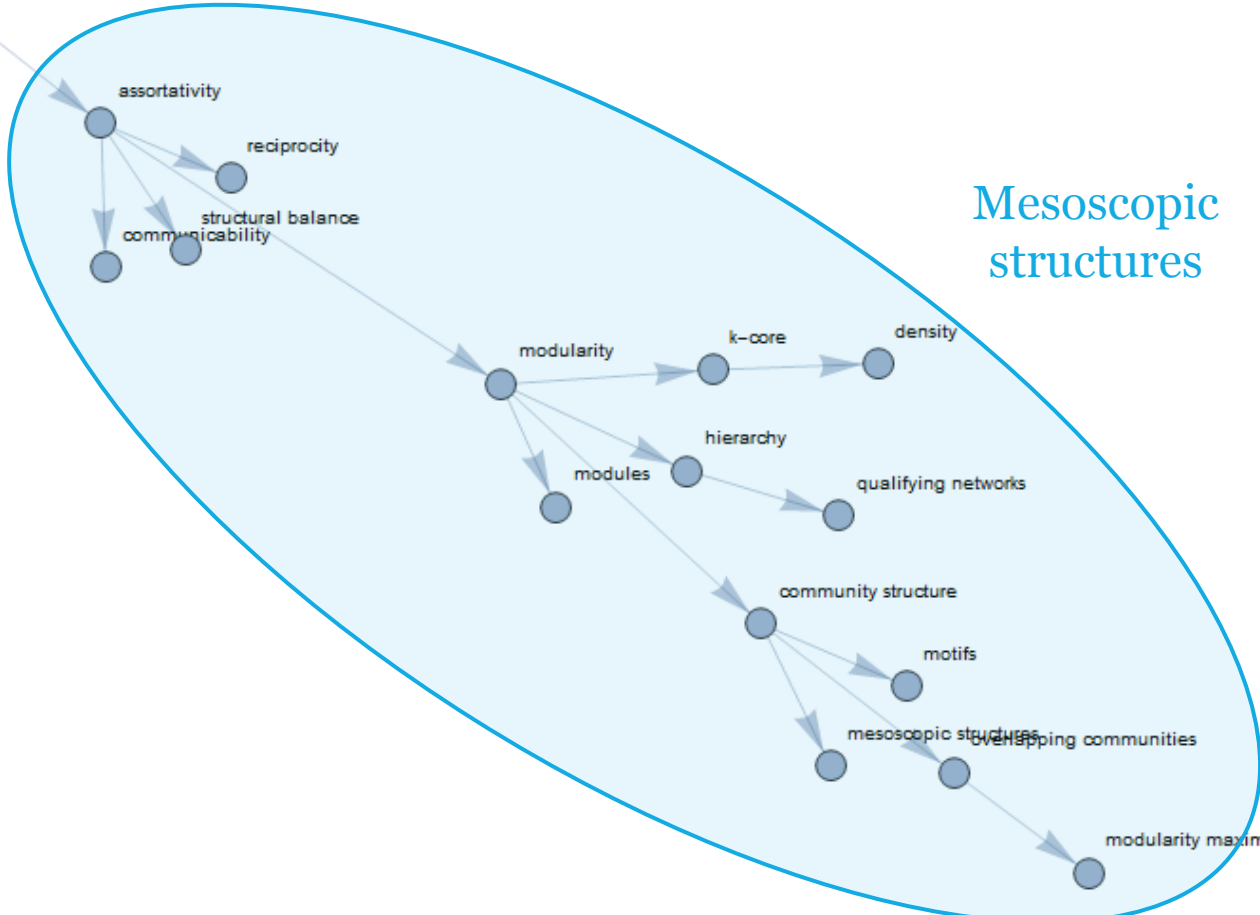
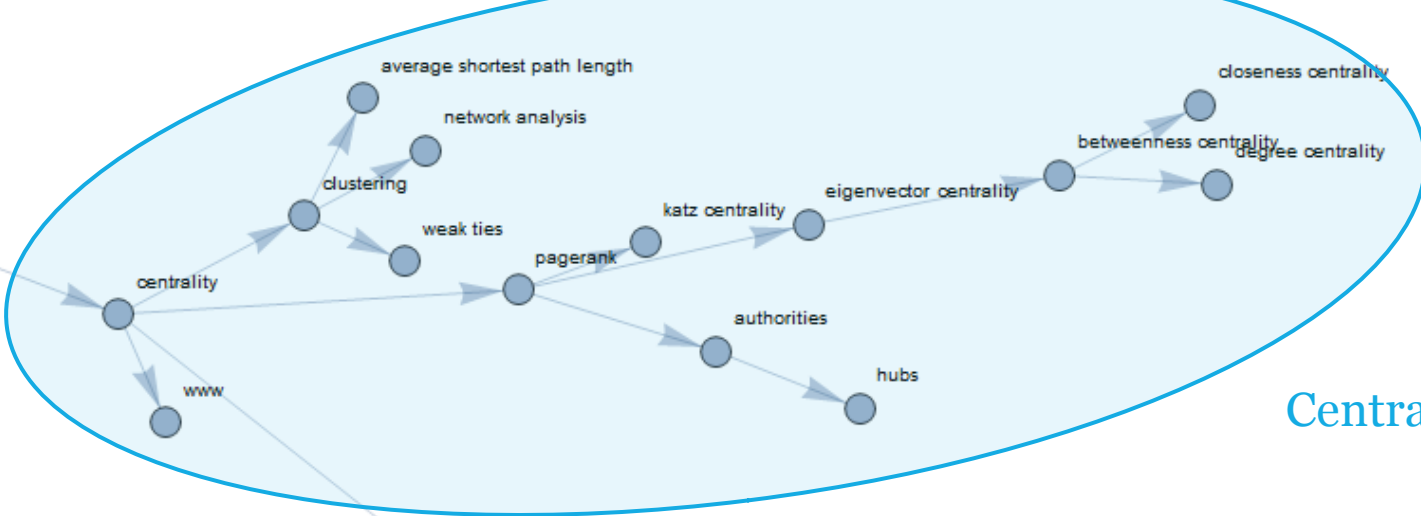


Small-world networks

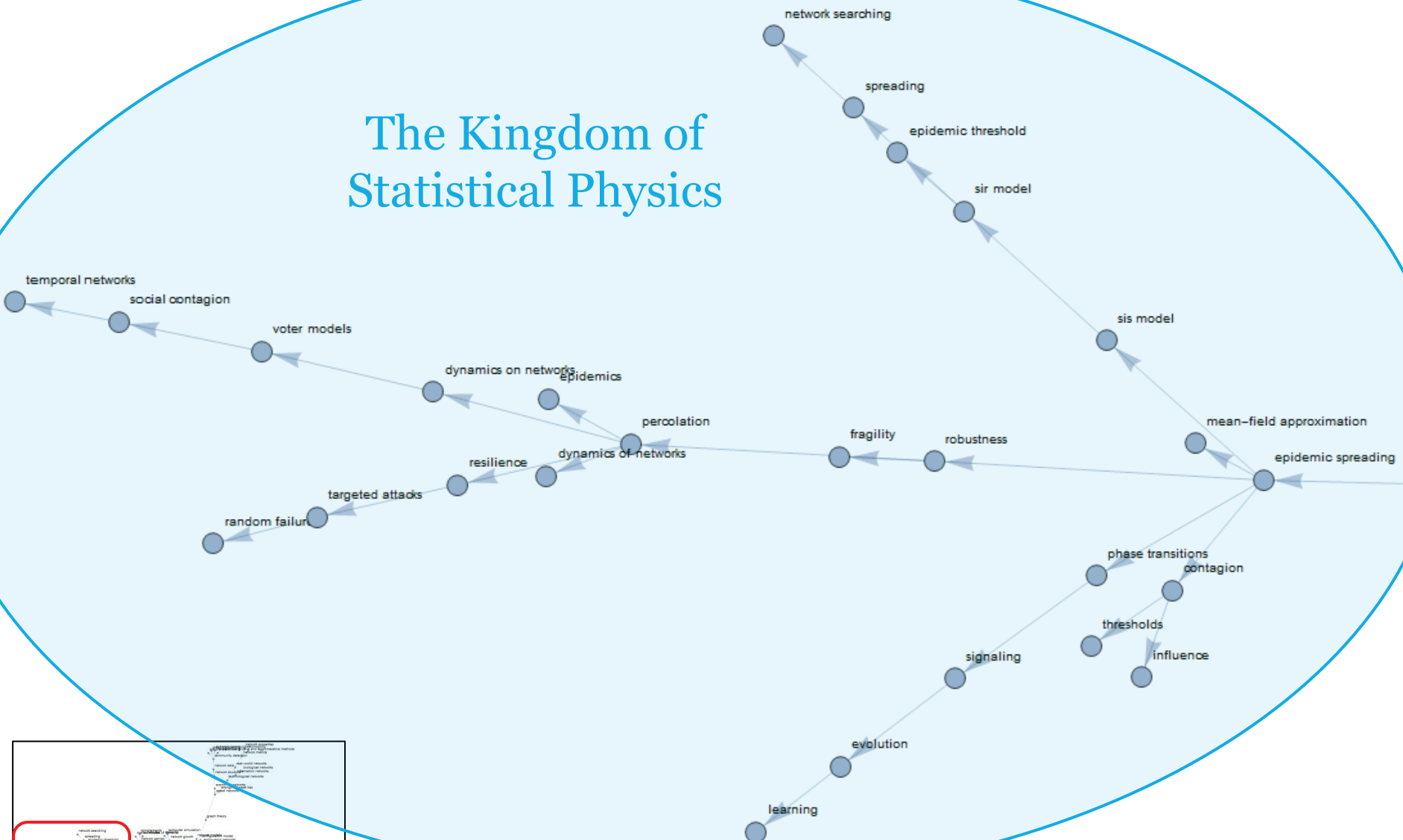




Basic concepts
& network
properties



The Kingdom of Statistical Physics



Communities

Basic concepts

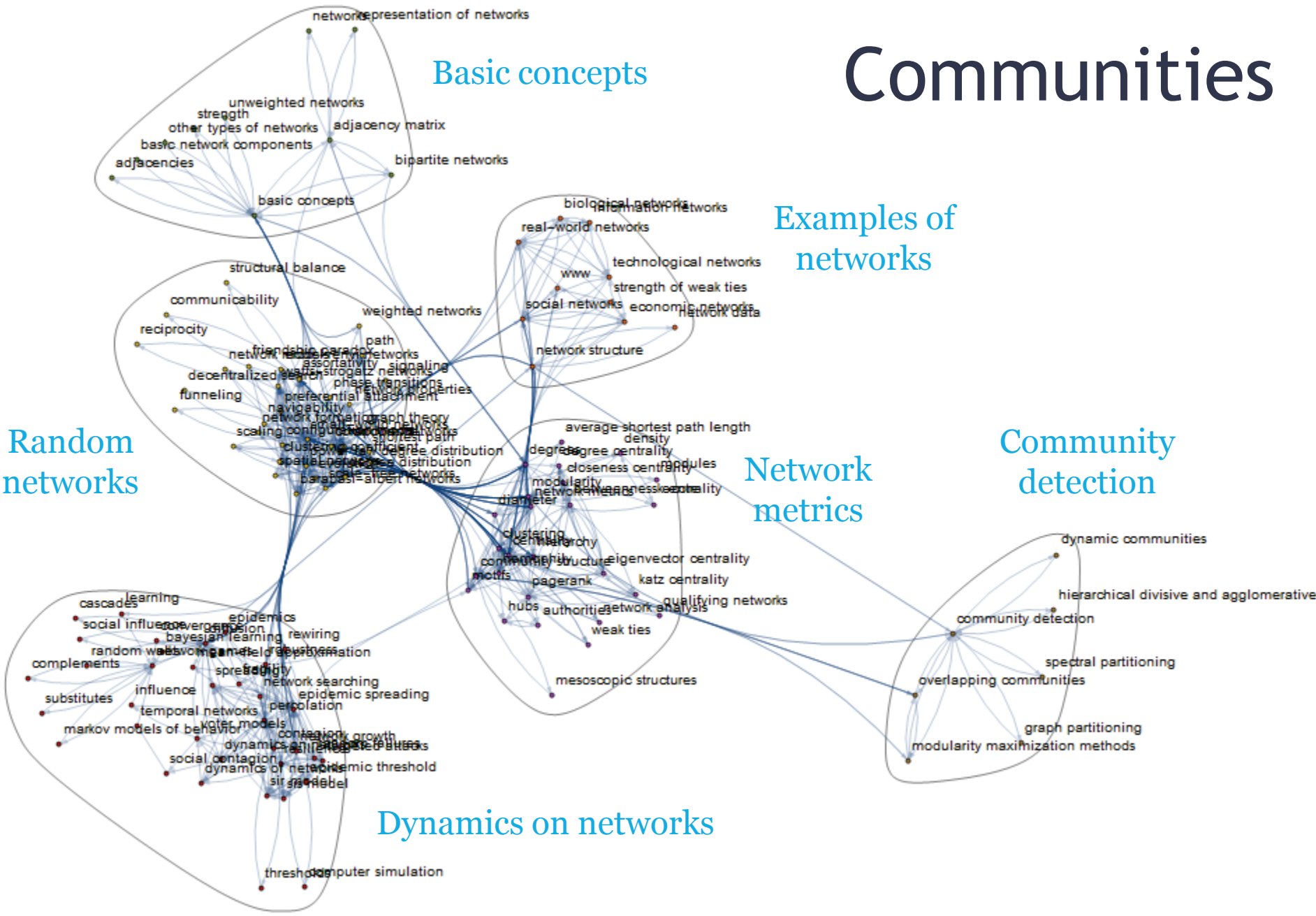
Examples of networks

Random networks

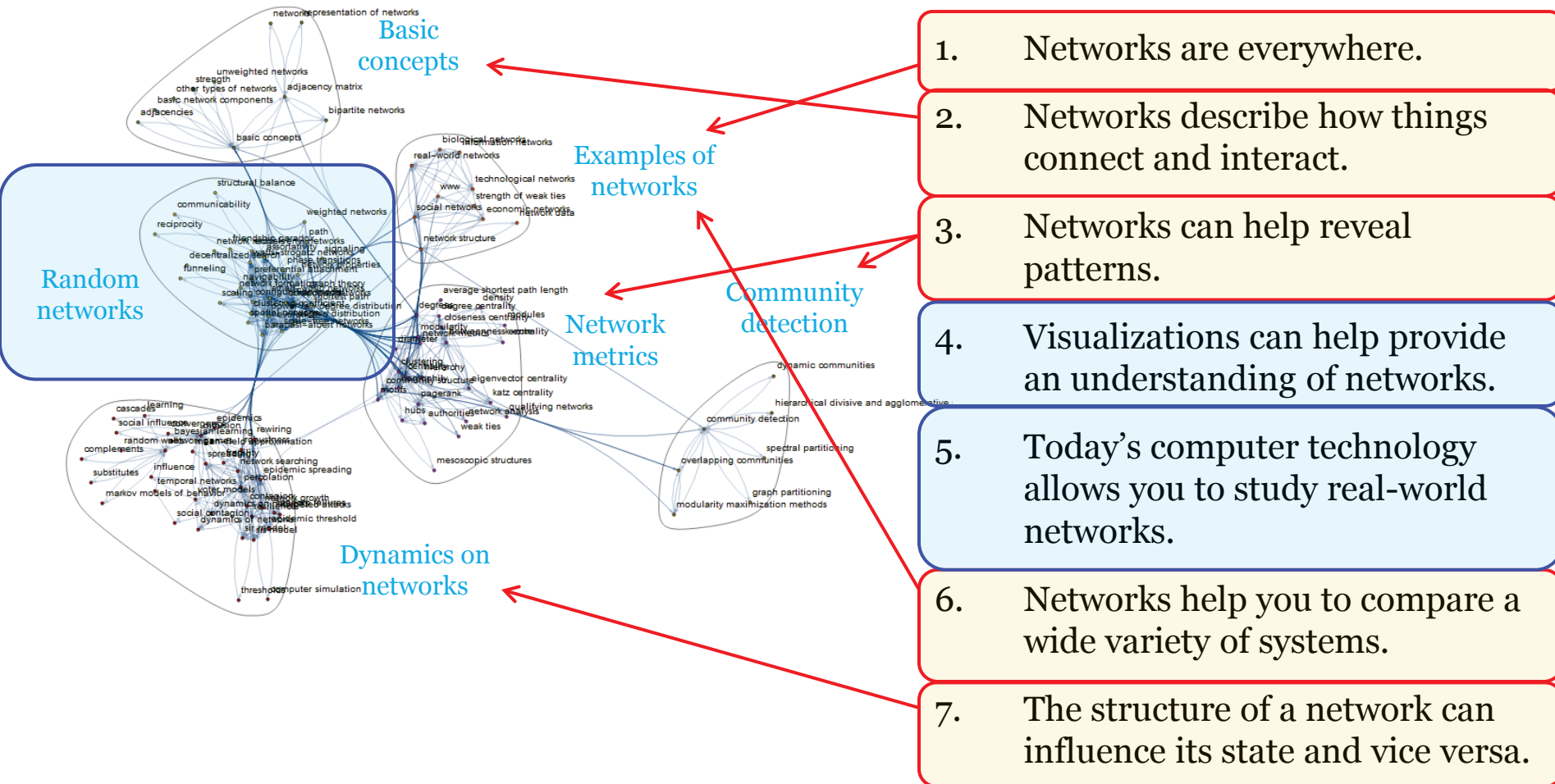
Network metrics

Community detection

Dynamics on networks



Comparison with “Network Literacy”



Conclusion

- We constructed a networked map of topics from 30 currently offered NetSci courses
- Spanning tree illustrates collectively formed curricular structure of network science
 - Socio-economical networks
 - Examples, network data analysis
 - Random networks, small-world networks
 - Basic concepts & network properties
 - Centralities & mesoscopic structures
 - Scale-free networks & growth
 - Diffusion & influence, network games
 - The Kingdom of Statistical Physics
- Communities show some overlap with Net. Lit.

Thank You