

Semester projects

Complex Networks, Course 303A, Spring, 2009

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Outline

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Requirements:

1. \approx 5 minute introduction to project (fourth week)
2. 15 to 20 minute final presentation
3. Report: \geq 5 pages (single space), journal-style

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Narrative hierarchy

Presenting at many scales:

- ▶ 1 to 3 word encapsulation, a soundbite,
- ▶ a sentence/title,
- ▶ a few sentences,
- ▶ a paragraph,
- ▶ a short paper,
- ▶ a long paper,
- ▶ ...

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topics

- ▶ Develop and elaborate an **online experiment** to study some aspect of **social phenomena**
- ▶ e.g., collective search, cooperation, cheating, influence, creation, decision-making, etc.

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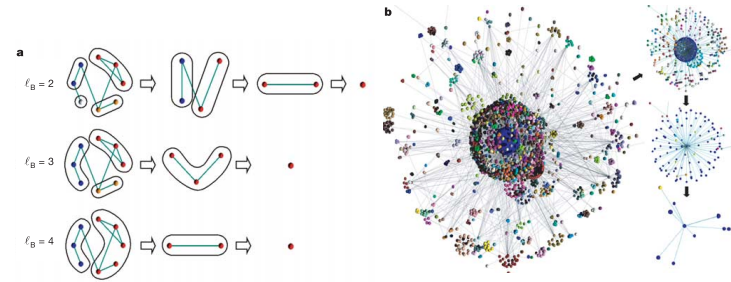
References

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topics

- ▶ Explore “self-similarity of complex networks” [15, 16]
First work by Song *et al.*, Nature, 2005.
- ▶ See accompanying comment by Strogatz [17]



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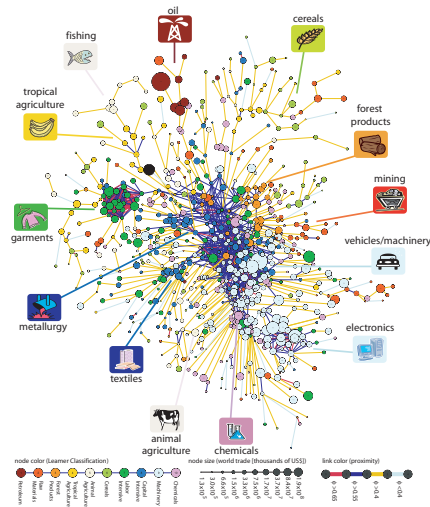
References

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topics

- ▶ Study Hidalgo *et al.*'s “The Product Space Conditions the Development of Nations” [9]
- ▶ How do products depend on each other, and how does this network evolve?



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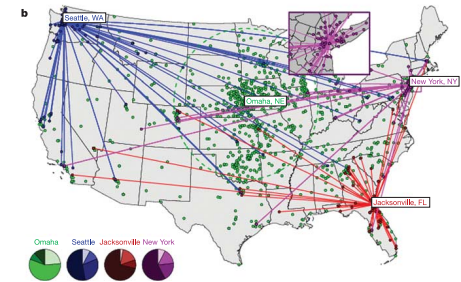
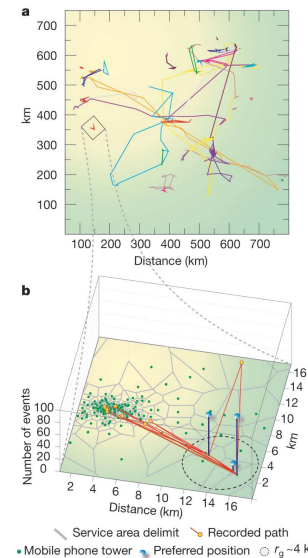
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topics



- ▶ Study movement and interactions of people.
- ▶ Brockmann *et al.* [2] “Where’s George” study.
- ▶ Barabasi’s group: tracking movement via cell phones [?].

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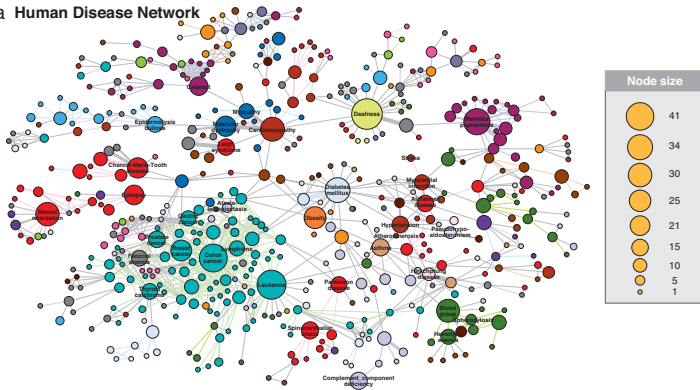
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topics

- ▶ Study the human disease and disease gene networks (Goh *et al.*, 2007):

a Human Disease Network



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topics

- ▶ Study **collective tagging** (or folksonomy)
- ▶ e.g., del.icio.us, flickr
- ▶ See work by Bernardo Huberman et al. at HP labs.

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topics

- ▶ Study games (as in game theory) on networks.
- ▶ For cooperation: Review Martin Nowak's recent piece in Science: "Five rules for the evolution of cooperation." [13]
- ▶ Much work to explore: voter models, contagion-type models, etc.

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topics

- ▶ **Semantic networks**: explore word-word connection networks generated by linking semantically related words.
- ▶ More general: Explore **language evolution**
- ▶ One paper to start with: "The small world of human language" by Ferrer i Cancho and Solé [8]
- ▶ Related: Study spreading of neologisms.

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topics

- ▶ Investigate **safety codes** (building, fire, etc.).
- ▶ What kind of relational networks do safety codes form? How have they evolved?

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topics

- ▶ Statistics: Study Peter Hoff's (and others') work on **latent variables**.
- ▶ Idea: explain connection pattern in a network through **hidden** individual or dyadic variables
- ▶ This method has been applied to the study of international relations networks.
- ▶ Related and large: explore work on p^* networks.

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topics

- ▶ Study Stuart Kauffman's **nk boolean networks** which model regulatory gene networks^[11]

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topics

- ▶ Engineering: Read and critically explore Bejan's book "Shape and Structure, from Engineering to Nature."^[1]
- ▶ Bejan asks why we see branching network flow structures so often in Nature—trees, rivers, etc.

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topics

- ▶ Explore work by Doyle, Alderson, et al. as well as Pastor-Satorras et al. on the structure of the [Internet\(s\)](#).

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topics

- ▶ Review: Study Castronova's and others' work on massive multiplayer online games. How do social networks form in these games? ^[3]

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topics

- ▶ Study **bipartite networks**: structure and dynamics
- ▶ Rich and interesting both mathematically and practically speaking.

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topics

- ▶ Study scientific collaboration networks.
- ▶ Mounds of data + good models.
- ▶ See seminal work by De Solla Price ^[14]. plus modern work by Redner, Newman, *et al.*

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topics

- ▶ Study Kearns et al.'s experimental studies of people solving classical graph theory problems^[12]
- ▶ “An Experimental Study of the Coloring Problem on Human Subject Networks”
- ▶ (Possibly) Run some of these experiments for our class.

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topics

- ▶ Biology: Study leaf network patterns (taken).
- ▶ Key on very interesting work by Xia.
- ▶ Classic Monge problem: how to move stuff from one place to another.
- ▶ Bulk flow versus network flow.

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topics

- ▶ Vague/Large:
Study amazon's recommender networks.

Customers Who Bought This Item Also Bought

Harry Potter Schoolbooks: [Fantastic Beasts and...](#) by J.K. Rowling
★★★★★ (465) \$10.19

[The Tales of Beedle the Bard, Collector's E...](#) by J. K. Rowling
★★★★★ (153)

[Harry, A History: The True Story of a Boy Wizar...](#) by Melissa Anelli
★★★★★ (52) \$10.88

[Inkdeath \(Inkheart\)](#) by Cornelia Funke
★★★★★ (41) \$16.49

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topics

- ▶ Vague/Large:
Study network evolution of the Wikipedia's content.



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topics

- ▶ Vague/Large: How is the media connected? Who copies whom?
- ▶ Possibly use NY Times API.
- ▶ <http://memetracker.org/>
- ▶ Problem: Need to be able to measure interactions.

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topics

- ▶ Vague/Large:
Anything interesting to do with large-scale networks in evolution, biology, ethics, religion, history, influence, food, international relations, ...

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References I

-  **A. Bejan.**
Shape and Structure, from Engineering to Nature.
Cambridge Univ. Press, Cambridge, UK, 2000.
-  **D. Brockmann, L. Hufnagel, and T. Geisel.**
The scaling laws of human travel.
Nature, pages 462–465, 2006.
-  **E. Castronova.**
Synthetic Worlds: The Business and Culture of Online Games.
University of Chicago Press, Chicago, IL, 2005.
-  **A. Clauset, M. Young, and K. S. Gleditsch.**
On the Frequency of Severe Terrorist Events.
Journal of Conflict Resolution, 51(1):58–87, 2007.
[pdf](#) (田)

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References II

-  **S. Douady and Y. Couder.**
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Part I: The spiral modes resulting from time-periodic iterations.
J. Theor. Biol., 178:255–274, 1996. [pdf](#) (田)
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Phyllotaxis as a dynamical self organizing process
Part II: The spontaneous formation of a periodicity and the coexistence of spiral and whorled patterns.
J. Theor. Biol., 178:275–294, 1996. [pdf](#) (田)
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References III

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-  [C. A. Hidalgo, B. Klinger, A.-L. Barabási, and R. Hausman.](#)
The product space conditions the development of nations.
Science, 317:482–487, 2007. [pdf](#) (田)
-  [N. F. Johnson, M. Spagat, J. A. Restrepo, O. Becerra, J. C. Bohorquez, N. Suarez, E. M. Restrepo, and R. Zarama.](#)
Universal patterns underlying ongoing wars and terrorism, 2006. [pdf](#) (田)

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References IV

-  [S. Kauffman.](#)
The Origins of Order.
Oxford, 1993.
-  [M. Kearns, S. Suri, and N. Montfort.](#)
An experimental study of the coloring problem on human subject networks.
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-  [M. A. Nowak.](#)
Five rules for the evolution of cooperation.
Science, 314:1560–1563, 2006. [pdf](#) (田)
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Science, 149:510–515, 1965. [pdf](#) (田)

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References V

-  [C. Song, S. Havlin, and H. A. Makse.](#)
Self-similarity of complex networks.
Nature, 433:392–395, 2005. [pdf](#) (田)
-  [C. Song, S. Havlin, and H. A. Makse.](#)
Origins of fractality in the growth of complex networks.
Nature Physics, 2:275–281, 2006. [pdf](#) (田)
-  [S. H. Strogatz.](#)
Romanesque networks.
Nature, 433:365–366, 2005. [pdf](#) (田)

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