

Semester projects

Complex Networks, Course 303A, Spring, 2010

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Outline

The Plan

Suggestions for Projects

References

Semester projects

The Plan

Suggestions for
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Frame 2/29



Requirements:

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

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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,
- ▶ ...

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

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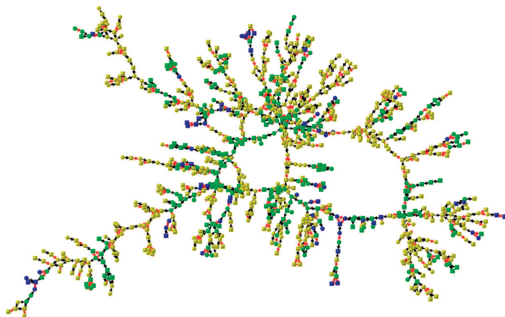
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Explore and critique Fowler and Christakis et al. work on social contagion of:

The Plan

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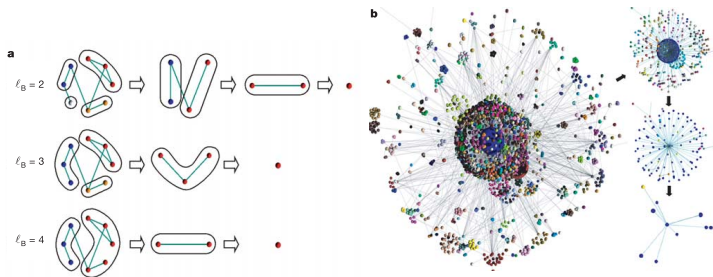


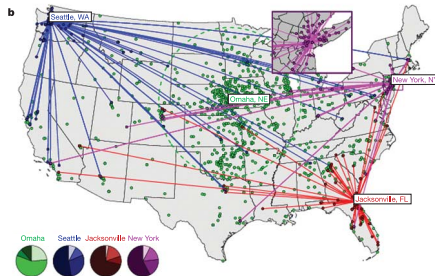
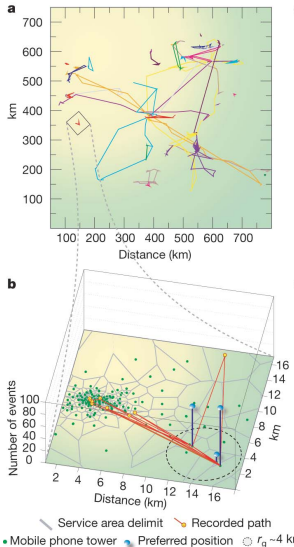
- ▶ Obesity^[5]
- ▶ Smoking cessation^[6]
- ▶ Happiness^[9]
- ▶ Loneliness^[3]

Figure 1. Loneliness clusters in the Framingham Social Network. This graph shows the largest component of friends, spouses, and siblings at Exam 7 (centered on the year 2000). There are 1,019 individuals shown. Each node represents a participant, and its shape denotes gender (circles are female, squares are male). Lines between nodes indicate relationship (red for siblings, black for friends and spouses). Node color denotes the mean number of days the focal participant and all directly connected (Distance 1) linked participants felt lonely in the past week, with yellow being 0–1 days, green being 2 days, and blue being greater than 3 days or more. The graph suggests clustering in loneliness and a relationship between being peripheral and feeling lonely, both of which are confirmed by statistical models discussed in the main text.

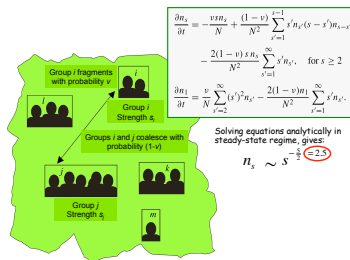
One question: how does the (very) sparse sampling of a real social network affect their findings?

- ▶ Explore “self-similarity of complex networks” [17, 18]
First work by Song *et al.*, Nature, 2005.
- ▶ See accompanying comment by Strogatz [19]

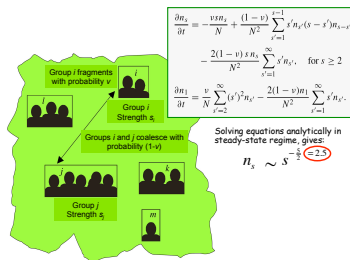




- ▶ Study movement and interactions of people.
- ▶ Brockmann *et al.* [2] “Where’s George” study.
- ▶ Barabasi’s group: tracking movement via cell phones [10].



- ▶ Physics/Society—**Wars**: Study work that started with Lewis Richardson’s “Variation of the frequency of fatal quarrels with magnitude” in 1949.
- ▶ Specifically explore Clauset et al. and Johnson et al.’s work [7, 12, 1] on terrorist attacks and civil wars



$$\frac{\partial n_s}{\partial t} = -\frac{v s n_s}{N} + \frac{(1-v)}{N^2} \sum_{s'=1}^{s-1} s' n_{s'} (s-s') n_{s-s'}$$

$$- \frac{2(1-v) s n_s}{N^2} \sum_{s'=1}^{\infty} s' n_{s'}, \quad \text{for } s \geq 2$$

$$\frac{\partial n_1}{\partial t} = \frac{v}{N} \sum_{s'=2}^{\infty} (s')^2 n_{s'} - \frac{2(1-v) n_1}{N^2} \sum_{s'=1}^{\infty} s' n_{s'}$$

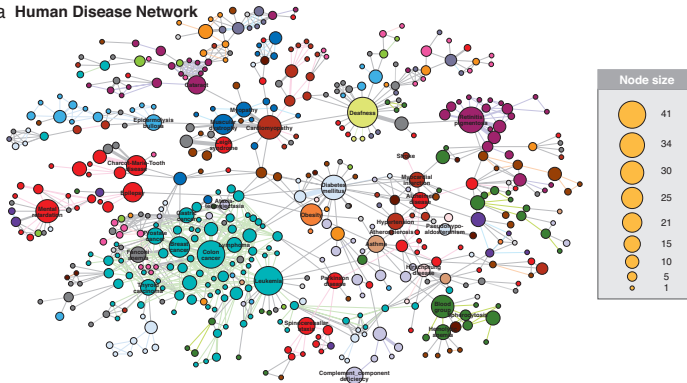
Solving equations analytically in steady-state regime, gives:

$$n_s \sim s^{-\frac{5}{2}} \approx 2.5$$

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

a Human Disease Network



- ▶ 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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- ▶ 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."^[15]
- ▶ Much work to explore: voter models, contagion-type models, etc.

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- ▶ **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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- ▶ Study Stuart Kauffman's *nk boolean networks* which model regulatory gene networks^[13]

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

- ▶ **Review:** Study work on massive multiplayer online games. How do social networks form in these games? ^[4]

- ▶ Study scientific collaboration networks.
- ▶ Mounds of data + good models.
- ▶ See seminal work by De Solla Price^[16] plus modern work by Redner, Newman, *et al.*

- ▶ Study Kearns et al.'s experimental studies of people solving classical graph theory problems^[14]
- ▶ “An Experimental Study of the Coloring Problem on Human Subject Networks”
- ▶ (Possibly) Run some of these experiments for our class.

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- ▶ Vague/Large:
Study amazon's recommender networks.
- ▶ See work by Sornette et al., Huberman et al.

Customers Who Bought This Item Also Bought

LOOK INSIDE!



[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)

LOOK INSIDE!



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

★★★★★ (52) \$10.88

LOOK INSIDE!



[Inkdeath \(Inkheart\)](#) by Cornelia Funke




★★★★★ (41) \$16.49

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





- ▶ 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.


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


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The Plan

Suggestions for
Projects





References

References V

The Plan

Suggestions for
Projects

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The Plan

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