

Social and Economic Networks

Fall 2021

Instructor: Rajeev Kohli

Overview

The purpose of the course is to provide an introduction to social and economic networks. A key focus is on understanding concepts and methods used for, and derived from, analyzing such networks. Most of these methods are central to the operations of companies like Facebook, Google, Twitter and Amazon. Among these are methods for identifying segments (communities) in networks; methods that are used by Google to rank search results, by Amazon to recommend products, and by Twitter to recommend customized stories and other individuals for a user to follow; auctions used for selling products as varied as flowers, tuna, art and search keywords; methods used by Facebook for placing advertising in a user's newsfeed; and mechanisms used for matching students to schools, cars to passengers (e.g., Uber, Lyft), and kidneys to patients.

Class sessions will combine lectures and discussions of assigned articles. All students are expected to actively contribute to class discussions and think critically about the concepts and issues discussed in the course.

Grading

40% two homeworks; 35% final exam; 25% class participation.

Readings

A pdf copy of the Easley and Kleinberg book *Networks, Crowds, and Markets: Reasoning About a Highly Connected World* is available on Jon Kleinberg's website: <https://www.cs.cornell.edu/home/kleinber/networks-book/>. Links to all other readings will be provided on Canvas.

Session 1. Introduction to social networks. Strong and weak ties. Community detection.

Required readings

- (1) Graphs, Chapter 2 in Easley, D. and J. Kleinberg.
- (2) Strong and Weak Ties, Chapter 3 in Easley and Kleinberg.

Optional reading

- (1) Blondel, V. D., J. L. Guillaume, R. Lambiotte, and E. Lefebvre (2008), “Fast unfolding of communities in large networks,” *Journal of Statistical Mechanics: Theory and Experiment*, 2008(10), P10008.

Session 2. Network centrality and its applications: hubs-and-authorities, Pagerank, Personalized Pagerank.

Required readings

- (1) Link Analysis and Web Search, Chapter 14 in Easley and Kleinberg.
- (2) Smith. B. and G. Linden (2017), “Two Decades of Recommender Systems at Amazon.com,” *IEEE Internet Computing*, 21(3), 12–18.

Optional readings

- (1) Goel, Ashish, et al. (2015), “The Who-To-Follow System at Twitter: Strategy, Algorithms, and Revenue Impact,” *Interfaces*, 45 (1), 98–107.
- (2) Elgammal, A. and B. Saleh (2015), “Quantifying Creativity in Art Networks,” <https://arxiv.org/abs/1506.00711>.

Session 3. Friendship paradox. Diffusion. Opinion leadership. Seeding information. Threshold models. Homophily & segregation.

Required readings

- (1) Networks in Their Surrounding Contexts, Chapter 4 in Easley and Kleinberg.
- (2) Feld, S. L. (1991), “Why Your Friends Have More Friends Than You Do,” *American Journal of Sociology*, 96 (6), 1464–1477.

Optional readings

- (1) Tufekci, Z. (2020), “This Overlooked Variable Is the Key to the Pandemic,” *Atlantic Magazine*.
<https://www.theatlantic.com/health/archive/2020/09/k-overlooked-variable-driving-pandemic/616548/>
- (2) Christakis, N. A. and J. H. Fowler (2010), “Social Network Sensors for Early Detection of Contagious Outbreaks,” *PloS One*, 5 (9), e12948.

Session 4. Information cascades and coordinated action.

Required readings

- (1) Granovetter, M. (1978), “Threshold Models of Collective Behavior,” *American Journal of Sociology*, 83 (6), 1420–1443.
- (2) Information Cascades, Chapter 16 in Easley and Kleinberg.
- (3) Cascading Behavior in Networks, Chapter 19 in Easley and Kleinberg.

Optional readings

- (1) Aral, S. (2014), “The problem with online ratings,” *MIT Sloan Management Review*, 55 (2), p.47–52.
- (2) González-Bailón, S., J. Borge-Holthoefer, A. Rivero and Y. Moreno (2011), “The dynamics of protest recruitment through an online network,” *Scientific Reports*, 1, 197. <https://doi.org/10.1038/srep00197>

Session 5. Auctions, Sponsored Search, VCG and GSP.

Required readings

- (1) Auctions, Chapter 9 in Easley and Kleinberg.
- (2) Sponsored Search Markets, Chapter 15 in Easley and Kleinberg.

Optional readings

- (1) Varian, H. R. and C. Harris (2014), “The VCG Auction in Theory and Practice,” *American Economic Review*, 104 (5), 442–45.
- (2) Metz, Cade (2015), “Facebook Doesn’t Make as Much Money as It Could — On Purpose,” *Wired*
<https://www.wired.com/2015/09/facebook-doesnt-make-much-money-couldon-purpose/>

Session 6. Market design. Matching in social and economic networks. Small worlds, power laws and rich-get-richer phenomena.

Required readings

- (1) Roth, A. E. (2007), “Art of Designing Markets,” *Harvard Business Review*.
- (2) The Small Worlds Phenomenon, Chapter 20 in Easley and Kleinberg.

Optional readings

- (1) Kleinfeld, J. (2002), “Could it be a Big World After All? The ‘Six Degrees of Separation’ Myth,” *Society*, April. http://www.columbia.edu/itc/sociology/watts/w3233/client_edit/big_world.html.