CS 685 The Structure of Information Networks	March 30, 2005

Reaction Paper 3

Due Date: April 13, 2005

The third reaction paper will cover the topics of power-law distributions and the small-world phenomenon. The topics are defined by the list of papers below.

If you covered one of these topics (community finding, for example) in one of your previous papers, you are welcome to revisit the topics of the first two papers.

Recall that a reaction paper will cover two related papers associated with this segment of lectures; at least one of these must not be on the given list. The reaction paper should be about three pages of discussion related to the papers. The discussion should go beyond a mere summary of the two papers. For instance, you might discuss some weaknesses in the papers, and suggest alternative approaches; formulate different hypotheses than the papers and suggest experiments that could be used to validate the hypotheses; discuss related work from a different field that the authors were not aware of, or a potential application of the work to a different field.

The papers listed below are the same as those listed on the web site under items 5 & 6; links to these papers can be found on the web site.

- **Power law distributions**

  Many properties of information networks obey power law distributions. Where has this been observed? What accounts for it? How can it be modelled?

  - Surveys
    - M. Mitzenmacher. A brief history of generative models for power law and lognormal distributions. Internet Mathematics, vol 1, No. 2, pp. 226-251, 2004.
    - R. Albert and A.-L.Barabasi. Statistical mechanics of complex networks. Reviews of Modern Physics 74, 47 (2002).
    - W. Aiello, F. Chung, L. Lu. Random evolution of massive graphs. Handbook of Massive Data Sets, (Eds. James Abello et al.), Kluwer, 2002, pages 97-122.
    - M.E.J. Newman. The structure and function of complex networks. SIAM Review 45: 167-256, 2003.
  - Papers
    - A.-L. Barabasi, R. Albert, and H. Jeong. Mean-field theory for scale-free random networks. Physica A 272 173-187 (1999).
    - B.A. Huberman, L.A. Adamic. Growth dynamics of the World-Wide Web. Nature, 399 (1999) 130.
    - M. Faloutsos, P. Faloutsos and C. Faloutsos. On power-law relationships of the Internet topology. ACM SIGCOMM 1999.
    - R. Kumar, P. Raghavan, S. Rajagopalan, D. Sivakumar, A. Tomkins, and E. Upfal. Stochastic models for the web graph. 41th IEEE Symp. on Foundations of Computer Science, 2000, pp. 57-65.

* B. Bollobas, C. Borgs, J. Chayes, and O. Riordan. Directed scale-free graphs Proceedings of the 14th ACM-SIAM Symposium on Discrete Algorithms (2003), 132-139.
* R. Kleinberg, J. Kleinberg. Isomorphism and embedding problems for infinite limits of scale-free graphs. Proc. 15th ACM-SIAM Symposium on Discrete Algorithms, 2005.
* A. Fabrikant, E. Koutsoupias, C. Papadimitriou. Heuristically Optimized Trade-offs: A new paradigm for power laws in the Internet. 29th International Colloquium on Automata, Languages, and Programming (ICALP), 2002.
* N. Berger, C. Borgs, J. Chayes, R. D'Souza, and R. Kleinberg. Competition-induced preferential attachment. To appear in Combinatorics, Probability, and Computing. Extended abstract appeared in Proceedings of the 31st International Colloquium on Automata, Languages, and Programming (ICALP 2004), pages 208-221.
* M. E. J. Newman, S. H. Strogatz and D. J. Watts. Random graphs with arbitrary degree distributions and their applications. Phys. Rev. E 64, 026118 (2001).
* Q. Chen, H. Chang, R. Govindan, S. Jamin, S.J. Shenker, W. Willinger. The origin of power laws in Internet topologies revisited. Proc. of IEEE Infocom 2002.
* J. Carlson and J. Doyle. Highly Optimized Tolerance: A mechanism for power laws in designed systems. Physical Review E 60:2(1999).
* A. Lakhina, J.W. Byers, M. Crovella, and P. Xie. Sampling biases in IP topology measurements. INFOCOM 2003.
* A. Clauset and C. Moore. Accuracy and scaling phenomena in Internet mapping. Physical Review Letters, 94:018701, 2005.
* D. Achlioptas, A. Clauset, D. Kempe, C. Moore. The bias of traceroute sampling. To appear in STOC 2005.
* D. Aldous. A tractable complex network model based on the stochastic mean-field model of distance. In Complex Networks, ed. E. ben-Naim, et al., pp. 51-87, 2004.

- **Small-world networks**

  Many social networks appear to have a "small world" property. What is the property? Where has it been observed? What accounts for it? How can it be modelled?

  - S. Milgram. The small world problem. Psychology Today 1(1967).
  - J. Travers and S. Milgram. An experimental study of the small world problem. Sociometry 32(1969).
  - P. Killworth and H. Bernard. Reverse small world experiment. Social Networks 1(1978).

- D.J. Watts and S. H. Strogatz. Collective dynamics of 'small-world' networks. Nature 393:440-42(1998).
- J. Kleinberg. The small-world phenomenon: An algorithmic perspective. Proc. 32nd ACM Symposium on Theory of Computing, 2000.
- J. Kleinberg. Small-world phenomena and the dynamics of information. Advances in Neural Information Processing Systems (NIPS) 14, 2001.
- D. J. Watts, P. S. Dodds, M. E. J. Newman. Identity and search in social networks. Science, 296, 1302-1305, 2002.
- J. Kleinfeld. Could it be a big world after all? The 'Six Degrees of Separation' myth. Society, April 2002.
- P.S. Dodds, R. Muhamad, D.J. Watts. An experimental study of search in global social networks. Science 301(2003), 827.
- F. Menczer. Growing and navigating the small world web by local content. Proc. Natl. Acad. Sci. USA 99(22): 14014-14019, 2002
- L. A. Adamic, R. M. Lukose, A. R. Puniyani, B. A. Huberman. Search in power-law networks. Phys. Rev. E, 64 46135 (2001).
- L. Adamic, E. Adar. How to search a social network. submitted to Social Networks, 2004.
- L.A. Adamic and B.A. Huberman. Information dynamics in a networked world. in: Eli Ben-Naim, Hans Frauenfelder, Zoltan Toroczkai, (Eds.), 'Complex Networks', Lecture Notes in Physics, Springer, 2003.
- A. Clauset and C. Moore. How do networks become navigable? preprint at arxiv.org, 2003.