MPhil in Advanced Computer Science
Social and Technological Networks (L109)

Leader: Cecilia Mascolo
Timing: Lent Term
Structure: 8 x 1-hour lectures

AIMS

This course aims to introduce concepts of complex and social network analysis and its application to real social and technological networks.

SYLLABUS

The course will consist of eight lectures covering the following material:

- Introduction to social networks and metrics;
- Small world networks and network distance;
- The importance of weak ties;
- Community detection;
- Power laws and the structure of the web;
- Internet and robustness;
- Network search and PageRank;
- Network cascades;
- Theory of epidemic dissemination;
- Network evolution.

The lectures will contain various examples from recent analysis of large and real social networks including telephone networks, online social networks and human contact networks.

OBJECTIVES

By the end of this module students should be familiar with the most common metrics and techniques of complex network analysis and classification, as well as the most recent applications of these techniques in the area of social and technological networks.

ASSESSMENT

1. One report (of approximately 1,500 words) on one assigned research paper. The report is due at the end of the course and it is worth 40% of the final mark.

   The report will contain two parts of about 750 words each:

- Critical analysis of the papers including, possibly, comparisons and references to other material presented in the course or found by the student and comments on how solid the result obtained are (e.g., comments on the evaluation methods or on the analysis applied can be included);
- Discussion of possible future research ideas in the area;

2. The second assignment will consist of analysis of an assigned dataset according to some indicated network measures using NetworkX: the analysis should be reported in a document of about 1,500 words where the results are commented and justified. This should be handed in by the end of the Lent Term and will be worth 60% of the final mark.

RECOMMENDED READING

1. D. Easley, J. Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. Cambridge University Press, 2010.
2. M. Newmann. Networks. Oxford University Press. April 2010. R. Albert, A. Barabasi. Statistical Mechanics of Complex Networks. Reviews of Modern Physics (74). Jan. 2002.
3. Watts, D.J.; Strogatz, S.H. (1998). "Collective dynamics of 'small-world' networks. Nature 393 (6684): 40910.
4. J. P. Onnela, J. Saramaki, J. Hyvonen, G. Szabo, D. Lazer, K. Kaski, J. Kertesz, A.
5. L. Barabasi. Structure and tie strengths in mobile communication networks. Proceedings of the National Academy of Sciences, Vol. 104, No. 18. (13 Oct 2006), pp. 7332-7336.
6. C. Marlow, L. Byron, T. Lento, and I. Rosenn. Maintained relationships on facebook. 2009. On-line at http://overstated.net/2009/03/09/maintained-relationships-on-facebook.
7. B. A. Huberman, D. M. Romero, and F. Wu. Social networks that matter: Twitter under the microscope. First Monday, 14(1), January 2009.
8. M. Girvan and M. E. J. Newman. Community structure in social and biological networks. Proc. Natl. Acad. Sci. USA, 99(12):78217826, June 2002.
9. A. Broder, R. Kumar, F. Maghoul, P. Raghavan, S. Rajagopalan, R. Stata, A. Tomkins, and J. Wiener. Graph structure in the Web. In Proc. 9th International World Wide Web Conference, pages 309-320,2000.
10. A. Clauset, C. R. Shalizi and M. E. J. Newman, 2009. Power-law distributions in empirical data. SIAM Review Vol. 51, No. 4. (2 Feb 2009), 661.
11. Barabsi, Albert-Lszl and Rka Albert, "Emergence of scaling in random networks", Science, 286:509-512, October 15, 1999
12. M. Salganik, P. Dodds, and D. Watts. Experimental study of inequality and unpredictability in an artificial cultural market. Science, 311:854-856, 2006.

13. R. Albert, H. Jeong, A.-L. Barabsi. Error and attack tolerance of complex networks. Nature 406, 378-482 (2000).

14. Cohen et al., Phys. Rev. Lett. 85, 4626 (2000)

15. D. S. Callaway, M. E. J. Newman, S. H. Strogatz, and D. J. Watts, Network robustness and fragility: Percolation on random graphs, Phys. Rev. Lett., 85 (2000), pp. 54685471.