COT 6938: Network Science

Spring 2016

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Office: HEC (Engr 3), Room 305
Class hours: Tue 6:00 - 8:50 PM
Office hours: Tue/Thu 3:00 - 4:30 PM
Class Venue: BA2, Room 221

Schedule and Notes

Pre-requisites:

Bachelors degree in EE, CS, CpE, (or equivalent), or CI.
Basic knowledge on Graph Theory, Probability Theory, Linear Algebra, and Differential Equations will be helpful.

Background and Objectives:

The course seeks to introduce fundamental elements of the emerging science of complex networks and their applications. Network science is a relatively new discipline that investigates the topology, structural properties, evolution dynamics, and vulnerabilities of complex networks, with an aim to better understand the variant and invariant properties of the underlying systems. The applications of network science span a wide variety of areas: Internet, physical, biological, ecology, and social systems. This course will emphasize on the algorithmic, computational, and statistical methods of network science, with special emphasis on information and social networks. Students will be taught algorithms, mathematical theories, and computational methods to analyze complex networks, and predict the behavior and evolution of networked systems. Students will also have the opportunity to review and present on a current research topic for a set of topics. Thus, there is a mandatory in-class presentation.

Course Syllabus:

Overview of basic concepts and history of network science, paths, components, degree distribution, clustering, degree correlations, centrality metrics, small-world property, scale-free property, heavy-tailed degree distributions, network motifs, Poisson networks, Watts-Strogatz model, preferential attachment and its variants, applications in communications and social networks, community identification and detection algorithms, percolation, vulnerabilities, resilience to random and targeted attacks, epidemics, immunization strategies, influence identification, games on networks, strategic network formation, evolution due to cooperation and non-cooperation on social networks.

Books:

We will mainly follow the book by Barabasi. Will do one chapter from the book by Newman. Will do selected topics from the book by Easley and Klienberg.

1. A. Barabasi, *Network Science* [Available online] [Chapters (2016)] [Slides (2014)]

2. M.E.J. Newman, Networks: An Introduction, Oxford University Press, 2010. [Website]
UCF library has this book in E-format.

3. D. Easley and J. Kleinberg, *Networks, Crowds and Markets,*
Cambridge Univ Press, 2010. You can download all the chapters from the book's website.

Grading Policy:

The topic review and presentation would constitute 30% of the grade. (5% for the 2-minute presentation, 15% for the final presenation, and 10% for the final report.) There will be 2 assignments (2 X 15%) and two exams (2 X 20%). There will be no final exam. Students have to make in-class presentations on their topic during the Finals week. Plus / minus grades will be used.

Tools

- Pajek: A simple network visualization tool allowing to interactively manipulate the network. (Pajek manual)
- Cytoscape: Network Data Integration, Analysis, and Visualization in a Box.
- D3: Data-Driven Documents.
- Graphviz: A simple network visualization tool available for a variety of platforms.
- GUESS: An exploratory data analysis and visualization tool.
- JUNG: A Java Universal Network/Graph Framework.
- UCINET: A social network visualization and analysis tool.
- iGraph: A software package for creating and manipulating undirected and directed graphs.
- NetworkX: A Python package for studying the structure, dynamics, and functions of complex networks.
- Net: A program for the creation and statistical analysis of large networks.
- graph-tool: A python module to help with statistical analysis.

Check these courses:

- Albert Barabasi, Northeastern University http://barabasilab.neu.edu/networksciencebook/
- Constantine Dovrolis, Georgia Tech. http://www.cc.gatech.edu/~dovrolis/Courses/NetSci/
- Michael Kearns, UPENN http://www.cis.upenn.edu/~mkearns/teaching/NetworkedLife/
- Mehmet Gunes, University of Nevada, Reno. http://www.cse.unr.edu/~mgunes/cs765/
- Assefaw Gebremedhin, Purdue https://www.cs.purdue.edu/homes/agebreme/Networks/
- Lada Adamic. http://www-personal.umich.edu/~ladamic/courses/networks/si508si708cs608/index.html
- Jon Kleinberg and Eva Tardos, Networks, Cornell. https://courses.cit.cornell.edu/info2040_2013fa/
- Jure Leskovek, Social and Information Network Analysis, Stanford. http://www.stanford.edu/class/cs224w/.
- Peter Dodds, Univ. of Vermont. http://www.uvm.edu/~pdodds/teaching/courses/2014-01UVM-303/index.html