CSC 495: Social Network Analysis

Professor Robin Burke
Spring 2014, Section 901/910, CDM 214
Th 5:45 — 9:00 pm

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Office hours: Mondays 1:00 – 2:30 pm (Lincoln Park, 990 W. Fullerton, Suite 3100) and Thursdays 3:30 – 5:00 pm and by appointment.
Course web site: http://d2l.depaul.edu/

Description

This course is an introduction to the concepts and methods of social network analysis. Students will learn to extract and manage data about network structure and dynamics, and to analyze, model and visualize such data. Students will use software tools to model and visualize network structure and dynamics. Specific network applications to be discussed include online social networks, collaboration networks, and communication networks. PREREQUISITE(S): CSC 423 or CSC 202 or SOC 412

Textbook: Jackson, M. O. *Social and Economic Networks*. Princeton U. Press, 2008. ISBN: 978-0-691-14820-5.
Other readings online as assigned.

Learning Objectives

After taking this class, students will be able to:

- Define key concepts in networks such as node, edges, path, geodesic, weighted and directed networks.
- Define and calculate key metrics such as degree, degree distribution, diameter, density, closeness, betweenness, local and global clustering.
- Interpret the results of computing various forms of centrality including Katz, Bonacich, eigenvector, and PageRank.
- Explain and distinguish between several key network models: random, growing random, Watts-Strogatz, preferential attachment, strategic formation, and exponential random graph.
- Analyze different types of networks to identify important actors, significant structural features such as communities, and overall network characteristics.
- Describe the consequences of different network structures for network processes including contagion and social influence.
- Use R to load, process, filter, manipulate, and compute metrics over a variety of networks.
- Apply QAP regression and exponential random graph modeling to test hypotheses about graph formation.
- Use Gephi to create effective network visualizations that communicate analytic findings about a network.

Assessment

Students will be assessed on the basis of 5 homework assignments, 4 labs, a midterm and a final project.

Homework (5): 30%
Labs (4): 15%
Midterm: 25%
Final project: 30%

Homeworks are due weekly by class time and **cannot be submitted late**. This enables us to discuss homework solutions in class.

Attendance at labs is optional, and lab assignments will be due the following week. Lab sessions will be recorded so on-line students can follow along to complete each exercise.

The final project will involve the creation of a network analysis using a data set of the student's choice. Students may work solo or in pairs on this assignment. There are four milestones for this project:

5/8: Project proposal
5/22: Project data
5/29: Draft visualizations
6/11: Project due

Tentative Schedule

4/3: Introduction
Introduction to the class. Syllabus and expectations. Steps in social network analysis: network definition, manipulation, calculation, visualization. Graph terminology and definitions. Representing networks: Adjacency matrix and properties. Weighted, directed, bipartite networks. Trees. Some sample networks.
Reading: Jackson, Ch. 1 and 2 through 2.1.2

4/10: Introduction to SNA in R / Lab
The R environment. Statnet, sna and igraph packages for social network analysis. Basic transformation and visualization tools. Lab: Loading, manipulating, visualizing and saving network data in R.
Reading: Butts, C. `network`, A package for Managing Relational Data in R.
Due: Homework 1

4/17: Linear Algebra / Graph Properties
Eigenvectors and eigenvalues. Graph Laplacian. Markov matrices. Paths, walks, cycles. Degree, density. Degree distribution. Diameter, average path length. Average and local clustering. Centrality measures: degree, betweenness, closeness, Katz, Bonacich.
Reading: Jackson, Ch. 2 from 2.1.3 (skim 2.3)
Due: Homework 2

4/24: Network Creation & Visualization / Lab
Gathering network data. Sampling and associated biases. Survey techniques. Bipartite networks and projections. Emprical findings in social networks: small worlds, clustering, degrees, power laws. Lab: Loading, manipulating, visualizing and saving network data in Gephi.
Reading: Jackson, Ch. 3, Gephi tutorials
Due: Homework 3

5/1: Midterm / Project Discussion

5/8: Network Formation: Random
Review of Poisson random graphs. Growing random networks. Preferential attachment. Properties and phase transitions. Degree distributions. Fitting networks to data. Exponential random graph models.
Reading: Jackson, Ch. 5. Robins, G. et al. An introduction to exponential random graph (p*) models for social networks.
Due: Project proposal

5/15: Network Modeling / Lab

Frameworks for evaluating results in network analysis: autocorrelation, matching techniques, QAP regression, exponential random graphs, and other models. Computational considerations. Lab: Applying ERGM analysis.
Reading: Goodreau, S. Advances in exponential random graph (p*) models applied to a large social network.
Due: Homework 4

5/22: Clustering / Lab

Graph partitioning. Spectral partitioning. Modularity and modularity maximization. Betweenness clustering. Lab: Calculating and comparing clustering approaches.
Reading: Jackson, Ch. 13.2 and Newman, M. E. J. Communities, modules and large-scale structure in networks.
Due: Project data

5/29: Network Formation: Strategic

Game theory basics: players, moves, payoffs. Nash equilibrium. Efficiency and optimality. Examples. Network formation as a game. Pairwise stability. Positive and negative externalities.
Reading: Jackson, Ch. 6, 9.9
Due: Draft visualizations

6/4: Processes on Networks

Diffusion on networks. SIS and SIR infection models and predictions. Search on networks. Networked adoption games.
Reading: Jackson, Ch. 7 and 8
Due: Homework 5

6/11: Final project

Policies

Students are expected to attend all classes and participate in in-class exercises. Class will start promptly. Students are individually responsible for material they may have missed due to absence or tardiness.

Assignments (except for designated group assignments) must represent a student's individual effort. While students are permitted to discuss assignments at the conceptual level, under no circumstances should students share code (electronically or otherwise). Use of sources without attribution constitutes plagiarism, a serious violation of academic integrity. Consult the assignment handouts or the instructor if you have questions about how or what to document. The bottom line: do all of your own original work and do not copy from fellow students or past assignments.

School Policies

Disability
Students who feel they may need an accommodation based on the impact of a disability should contact me privately to discuss their specific needs. All discussions will remain confidential.
To ensure that you receive the most appropriate reasonable accommodation based on your needs, contact me as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the:PLuS Program (for LD, AD/HD) at 773-325-1677, Student Center #370, and/or The Office for Students with Disabilities (for all other disabilities) at 773-325-1677, Student Center #370

Online Instructor Evaluation
Course and instructor evaluations are critical for maintaining and improving course quality. To make evaluations as meaningful as possible, we need 100% student participation. Therefore, participation in the

School's web-based academic administration initiative during the eighth and ninth week of this course is a requirement of this course. Failure to participate in this process will result in a grade of incomplete for the course. This incomplete will be automatically removed within seven weeks after the end of the course and replaced by the grade you would have received if you had fulfilled this requirement.

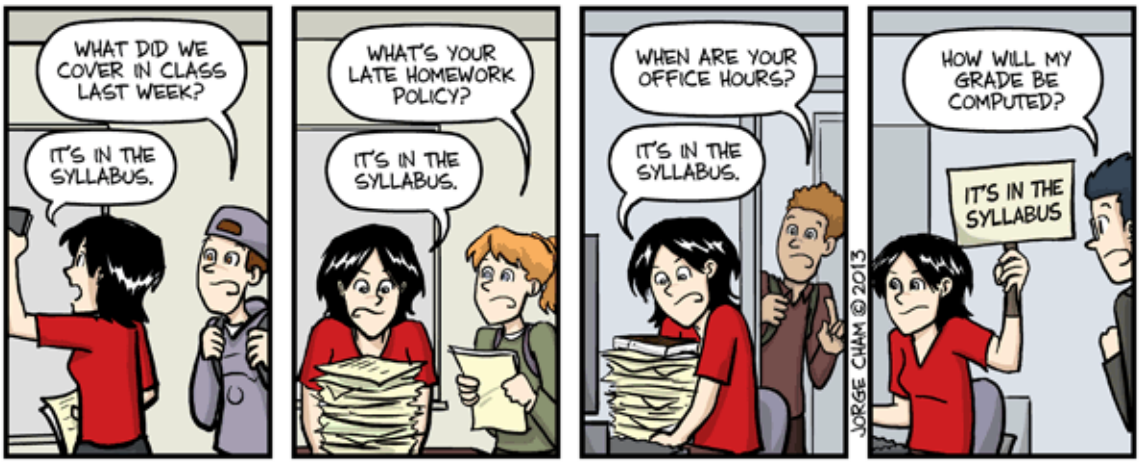
Email
Email is the primary means of communication between faculty and students enrolled in this course outside of class time. Students should be sure their email listed under "demographic information" at http://campusconnect.depaul.edu/ is correct.

Plagiarism
The university and school policy on plagiarism can be summarized as follows: Students in this course, as well as all other courses in which independent research or writing play a vital part in the course requirements, should be aware of the strong sanctions that can be imposed against someone guilty of plagiarism. If proven, a charge of plagiarism could result in an automatic F in the course and possible expulsion. The strongest of sanctions will be imposed on anyone who submits as his/her own work a report, examination paper, computer file, lab report, or other assignment which has been prepared by someone else. If you have any questions or doubts about what plagiarism entails or how to properly acknowledge source materials be sure to consult the instructor.

Incomplete
An incomplete grade is given only for an exceptional reason such as a death in the family, a serious illness, etc. Any such reason must be documented. Any incomplete request must be made at least two weeks before the final, and approved by the Dean of the College of Computing and Digital Media. Any consequences resulting from a poor grade for the course will not be considered as valid reasons for such a request.

Quarter at a Glance

Week	Date	Reading	Topic	Due
1	4/3	Jackson, Ch 1, Ch. 2 through 2.1.2	Introduction	
2	4/10	Butts, `network`, A package…	Introduction to SNA in R / Lab	Homework 1
3	4/17	Jackson, Ch. 2 from 2.1.3. Skim 2.3	Linear Algebra / Graph Properties	Homework 2
4	4/24	Jackson, Ch. 3. Gephi tutorials.	Network Creation & Visualization / Lab	Homework 3
5	5/1		Midterm / Project Discussion	
6	5/8	Jackson, Ch. 5. Robins, G. et al. An introduction…	Network Formation: Random	Project proposal
7	5/15	Goodreau, S. Advances in…	Network Modeling / Lab	Homework 4
8	5/22	Jackson, Ch. 13.2 and Newman, M. E. J. Communities, modules…	Clustering / Lab	Project data
9	5/29	Jackson, Ch. 6, 9.9	Network Formation: Strategic	Draft visualizations
10	6/4	Jackson, Ch. 7 and 8	Processes on Networks	Homework 5
Finals	6/11			Final Project



IT'S IN THE SYLLABUS

This message brought to you by every instructor that ever lived.

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