Course Syllabus

SI 608 – Networks

Instructor: Ceren Budak (email: cbudak@umich.edu, office: NQ 3336, office hours: 1-3pm Wednesdays)

Class Sessions: Tuesdays 8:30-11:30am, Room: NQ2185

Course Overview

We will cover topics in network analysis in this course, including social networks and information networks (e.g., the web). We will introduce basic concepts in network theory, metrics to characterize networks, models to explain the generation of networks, and methods to further analyze networks. In the lab sessions, the students will experience various analysis tools to analyze real-world network data. In the second half of the course, we will introduce a wide variety of applications of network analysis to real-world problems such as information retrieval. The final course project will provide students the opportunity to apply the concepts and techniques learned in class to networks of their interest. Students will also participate in the class through paper presentations.

Learning Objectives

Upon completion of this course, students should be able to:

- Understand basic concepts and metrics in network analysis
- Understand how to characterize, model, and analyze a network
- Utilize a variety of tools to manage, measure, visualize, and analyze networks
- Apply concepts and techniques of network analysis to real-world problems involving networks
- Start working toward becoming a professional with expertise in network analysis

Course Evaluation

- Paper presentations (10%): Each week (except for the first 2 and the last weeks), one group of students will read, prepare, and present a summary of a paper that builds on concepts covered the week before. The students will need to form groups in the first two weeks and sign up for slots.
- Four homework assignments (30%): No late submissions will be accepted under any normal circumstances. Extensions will only be granted under extreme circumstances to students with documented reasons (e.g. medical) at the instructor's discretion.
- Midterm Exam (20%): The midterm is take-home. Students have roughly a week to work on it.
- Course Project (40%): The projects will be a group effort. Students need to form groups (3-4 people) and define their project in the first few weeks of the class.
  - Proposal: 4%
  - Midterm Evaluation: 8%
  - Final presentation: 8%
  - Final report: 20%
**Late homework policy:** The homework assignments are due when the next class begins. No late submissions will be accepted under *any* normal circumstances. Extensions will only be granted under extreme circumstances to students with *documented* reasons (e.g. medical) at the instructor's discretion.

**Lab submission policy:** Second half of each class will be a lab session. The lab submissions are due the end of the class and will be in person. Labs will not be graded (best effort) but effort will count against class participation.

**Class format**

Typical format will be as follows:

- Student paper presentations (except for week 1, 2, and 14): ~40 mins
- Lecture: ~90-120 mins
- Lab/Project: ~20-50 mins

**Text**

- David Easley and Jon Kleinberg. Networks, Crowds, and Markets. To be published by Cambridge University Press, Spring 2010. ([EK2010](#))

**Classroom Policy**

Students are asked to attend class on time and remain through the entire class. Students will need to bring their laptops for the in-class labs.

**Original Work**

Unless otherwise specified in an assignment all submitted work must be your own, original work. Any excerpts, statements, or phrases from the work of others must be clearly identified as a quotation, and a proper citation provided. Any violation of the School’s policy on Academic and Professional Integrity (stated in the Master’s and Doctoral Student Handbooks) will result in serious penalties, which might range from failing an assignment, to failing a course, to being expelled from the program. Violations of academic and professional integrity will be reported to UMSI Student Affairs. The faculty instructor determines the consequences impacting assignment or course grades; the Assistant Dean for Academic and Student Affairs may impose additional sanctions.

**Accommodations for Students with Disabilities**

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way we teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate
accommodations. SSD (734-763-3000; http://www.umich.edu/sswd/) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information you provide as private and confidential.

**Student Mental Health and Wellbeing**

The University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) at (734) 764-8312 and https://caps.umich.edu/ during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service (UHS) at (734) 764-8320 and https://www.uhs.umich.edu/mentalhealthsvcs, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources.

For a listing of other mental health resources available on and off campus, visit: http://umich.edu/~mhealth/

**Schedule (Tentative)**

- **Week 1 (September 3): Course Overview; Introduction to Networks**
  - Reading material:
    - EK2010 Chapter 1&2
    - N2003 Section 1-3
    - Mislove et al. 2007 “Measurement and analysis of online social networks.”
    - Ahn et al. 2007 “Analysis of topological characteristics of huge online social networking services.”
    - Kwak et al. 2010 What is twitter, a social network or a news media?
  - Lab: Introduction to NetworkX

- **Week 2 (September 10): Basic Concepts. Network Metrics I**
  - Reading material:
    - EK2010 Chapter 2,3&14 (introductory material from Chapter 14)
    - Friedkin, N. E. "Structural Bases of Interpersonal Influence in Groups: A Longitudinal Case Study." American Sociological Review. 58. 6 (1993): 861. (JSTOR account required for article)

- Pajek Chapter 6: Center and Periphery
- Pajek Chapter 9: Prestige
- Lab: Centrality in NetworkX

**Week 4 (September 24): Small-world Networks. Network Models I**

- Paper presentation – Group 2 will read and present a summary of:
  - “Structural Bases of Interpersonal Influence in Groups: A Longitudinal Case Study.” By Friedkin, N. E.
- **Reading material:**
  - EK2010 Chapter 20: Small World Phenomenon
  - N2003 Section 6
- **Lab:** Small World Networks
- *Project proposals are due
- HW 1 released

**Week 5 (October 1): Scale-free Networks. Network Models II**

- Paper presentation – Group 3 will present either one of:
  - “Identity and Search in Social Networks” by Duncan J. Watts, Peter Sheridan Dodds, and M. E. J. Newman
  - “Four degrees of separation” by Lars Backstrom et al.
- **Reading material:**
  - "Power laws, Pareto distributions and Zipf’s law" M. E. J. Newman
  - "Topology of Evolving Networks: Local Events and Universality" Réka Albert and Albert-László Barabási
  - "Emergence of Scaling in Random Networks" Albert-Laszlo Barabasi and Reka Albert
  - EK Chapter 18
- **Lab:** Scale Free Networks
- HW 1 due

**Week 6 (October 8): Networks over Time**

- Paper presentation – Group 4 will present
  - “Scale-free networks are rare” by Broido and Clauset
- **Reading material:**
  - "Empirical Analysis of an Evolving Social Network" Gueorgi Kossinets and Duncan J. Watts
  - "Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance" Roger Guimerà, Brian Uzzi, Jarrett Spiro, and Luís A. Nunes Amaral
"Group Formation in Large Social Networks: Membership, Growth, and Evolution" Lars Backstrom, Dan Huttenlocher, Jon Kleinberg

"Graphs over Time: Densification Laws, Shrinking Diameters and Possible Explanations" Jure Leskovec, Jon Kleinberg, Christos Faloutsos

- Lab: Networks over Time
- *HW 2 assigned

**October 15 – Fall break**

**Week 7 (October 22): Communities**

- Paper presentation – Group 5 will choose from many papers that relate to graph characteristics:
  - “The Anatomy of the Facebook Social Graph” by Ugander et al.
- **Reading material:**
  - Heuristics for community detection, K-means clustering, betweenness clustering, and modularity
  - “Friends and Neighbors on the Web” Adamic, Adar
  - “A Social Network Caught in the Web” Adamic et al.
  - “Finding community structure in very large networks” Clauset et al. 2004
  - “Community structure in social and biological networks” Girvan, Newman 2001
  - “Community Detection and Mining in Social Media” by Tang et al. 2010
- *HW 2 due

**Week 8 (October 29): Ranking, Web**

- Paper presentation – Groups 6&7 will each present one of the following papers:
  - “Statistical Properties of Community Structure in Large Social and Information Networks” J. Leskovec, K. Lang, A. Dasgupta, M. Mahoney.
  - “Finding community Structure in Very Large Networks” Clauset et al. 2004
  - “The ground truth about metadata and community detection in networks” Peel et al.
- **Reading material:**
  - EK2010 Chapter 13&14
  - “LexRank: Graph-based Lexical Centrality as Salience in Text Summarization” Erkan, Radev 2004
- *Midterm assigned

**Week 9 (November 5): Classification and Recommendation**

- Paper presentation – Group 8&9 each will present one of the following papers:
  - “The authority of Supreme Court precedent” James H. Fowler and Sangick Jeon 2008
  - “Graph Structure in the Web.” Broder et al. 2000
- **Reading material:**
  - “Iterative Classification in Relational Data” Neville, Jensen 2000
  - “Node classification in social networks” Bhagat et al. 2011
  - “Predicting Positive and Negative Links in Online Social Networks” Leskovec et al. 2010
  - “Query Suggestion Using Hitting Time” Mei et al. 2008
  - “Experimental Study of Inequality and Unpredictability in an Artificial Cultural Market” Salganik et al. 2006
- *Midterm due*
*HW 3 assigned

**Week 10 (November 12): Diffusion and Cascades + Project midterm evals**
- Paper presentation – Group 10&11 will present:
  - “Experimental Study of Inequality and Unpredictability in an Artificial Cultural Market” Salganik et al. 2006
  - “Query Suggestion Using Hitting Time” Mei et al. 2008
- **Reading material:**
  - “Diffusion of Innovations.” Everett Rogers (this is a book, I don’t expect you to read all of it but it is a nice reference book you should be aware of)
  - “Everyone’s an influencer: Quantifying Influence on Twitter” Bakshy et al.
  - EK2010 Chapters 19, 21
- *HW 3 due

**Week 11 (November 19): Influence vs. Homophily**
- Paper presentation – Group 12&13 will each present one of the following papers:
  - “Everyone’s an influencer: Quantifying Influence on Twitter” Bakshy et al.
  - “The structure of Virality of Online Diffusion” by Goel et al.
- **Reading material:**
  - EK2010 Chapter 4: Networks in their surrounding contexts
  - "Maximizing the Spread of Influence Through a Social Network" Kempe et al. 2003
  - "Cost-Effective Outbreak Detection in Networks" Leskovec et al. 2007
  - "Influence and Correlation in Social Networks" Anagnostopoulos et al. 2009
  - “Randomization tests for distinguishing social influence and homophily effects” La Fond et al. 2010
- *HW 4 assigned

**Week 12 (November 26): Network Resilience**
- Paper presentation – Group 14&15 will each present one of the following papers:
  - “Origins of Homophily in an Evolving Social Network” by Kossinets et al.
  - "Influence and Correlation in Social Networks" Anagnostopoulos et al. 2009
  - “Randomization tests for distinguishing social influence and homophily effects” La Fond et al. 2010
  - “Social Structural Determinants of Similarity among Associates” Feld 1982
- **Reading material:**
  - TBD
- HW 4 due

- **Week 13 (December 3): Graph Traversal/Search**
  - Paper presentation – Group 16&17 will each present one of the following papers:
    - TBD
    - “Social Structural Determinants of Similarity among Associates” Feld 1982
  - **Reading material:**
    - Breadth-first, depth-first, greedy best-first, and A* search algorithms
    - Sections 3&4 in “Artificial Intelligence: A Modern Approach.” Russell and Norvig (but the material presented in the slides should suffice.)

- **Week 14 (December 10): Final Project Presentation**
  - *Project reports due

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**Course Summary:**

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<tr>
<td>Tue Sep 10, 2019</td>
<td><a href="https://umich.instructure.com/courses/318528/assignments/831977">Assignment 0</a> due by 8:30am</td>
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