Social and Information Networks Analysis

Graduate Course (ID: 22817), Department of Mathematical Sciences, Sharif University of Technology, Fall 2013

Time: Sunday and Tuesday, 8-9:30am

Instructor: Mostafa Salehi

TAs: Arezoo Rajabi, Payam Siyari

Description and Objectives:

Many real-world communication systems such as the Internet, World Wide Web (WWW), and Online Social Networks (OSNs) can be characterized by the interplay between rich information content. Indeed, we live in a world of networks. Network analysis has its origins in the mathematical study of networks, known as graph theory. However, unlike classical graph theory, the analysis primarily deals with real-life networks that are large and complex—neither uniformly random nor ordered, but have a more structured architecture. A network is defined by a collection of nodes (vertices) and links (edges) between pairs of nodes. For example, nodes in a social network usually represent individuals, while links may represent associations such as social interactions.

This course, designed at the introductory graduate level, will cover recent research on the structure and analysis of such large social and information networks and on models and algorithms that abstract their basic properties. Class will explore how to practically analyze large scale network data and how to reason about it through models for network structure and evolution.

Prerequisites:

Students are expected to have the following background: (1) Basic knowledge to write a computer program, (2) Basic probability theory, (3) Basic linear algebra

Course References:

Textbook (required):

We will be using following books as course reference. A list of required and supplemental readings will be posted periodically on the course web site. The course will be based on a list of required and supplemental readings (research papers) which will be posted periodically on the course web site.

- (Ref1) M. E. J. Newman, Networks: An Introduction, 2010.
- (Ref2) Laszlo Barabasi et al., Network Science, in progress.
- (Ref3) D. Easley and J. Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World, 2010.

Grading:

- Homeworks (theory and simulation): 40%
- Research Project: 10%
- Quizzes: 10%
- Midterm Exam: 20%
- Final Exam: 20%

Mailing list:

All students should join the course announcement website on Piazza.

Lectures and Readings:

The slides of lectures will be posted periodically on the course website on Piazza. If you don't have @sharif.edu email address, send me your email and I will manually register you to Piazza

- Lecture01 (92/06/24): **Course Overview**
  - Readings: Chapter 1 of Ref2, Chapter 1 ~ 5 of Ref1
- Lecture02 (92/06/31): **Network Mathematics**
  - Readings: Chapter 2 of Ref2, , Chapter 6 of Ref1
- Lecture03 (92/07/02, 92/07/07): **Random Networks, Small world Property**
  - Readings: Chapter 3 of Ref2, Chapter 12 of Ref1
- Lecture04 (92/07/14, 92/07/16): **Scale-free Property**
  - Readings: Chapter 4 of Ref2, Sections 8.3 & 8.4 of Ref1
- Lecture05 (92/07/21, 92/07/23): **Models of network formation: Barabasi-Albert, Small world, Copying**
  - Readings: Chapter 5 of Ref2, Chapters 14 & 15 of Ref1
- Lecture06 (92/07/30, 92/08/05): **Centrality metrics (Degree, Eigenvector, Katz, PageRank, Hubs and authorities, Closeness, Betweenness)**
  - Readings: Chapter 7 of Ref1
- Lecture07 (92/08/12, 92/08/14): **Measuring Network Properties (Similarity, Homophily, Assortative mixing, Reciprocity, Motifs, and**

Signed links)

- Readings: Chapter 7 of Ref1

- (92/08/19, 92/08/21): Review of covered materials

- Lecture08 (92/08/26): **Cascading Behavior - Decision Based Models of Cascades**

  - Readings: Chapter 19 of Ref3

- Lecture09 (92/08/28): **Cascading Behavior - Epidemics**

  - Readings: Chapter 21 of Ref3

- (92/09/03): Midterm Exam

- Lecture10 (92/09/10): **Crowdsourcing**

- Lecture11 (92/09/12): **Network Sampling**

- Lecture12 (92/09/17): **Spectral Graph Analysis**

- Lecture13 (92/09/19): **Community Detection**

- Lecture14 (92/09/24): **Link Prediction and Network Inference**

- Lecture15 (92/09/26): **Influence Maximization & Outbreak Detection**

- Lecture16 (92/09/01): **Mining Heterogeneous Information Networks**

- Lecture17 (92/09/03): **Game Theory & Network Analysis**