Amirkabir University of Technology
(Tehran Polytechnic)

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Social Network Analysis in Healthcare Course

Amirkabir University of Technology

Winter 2020

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Overview

Networks are all around us and we, as individuals, are ourselves the units of a network of social relationships of different kinds and, as biological systems, the delicate results of a network of biochemical reactions. Study of networks was started by Leonhard Euler and published in response to the Konigsberg bridge problem.

A diverse array of deep questions about human behavior can only be answered by examining the social networks encompassing and shifting around us. This network analysis has emerged as a cross-disciplinary science in its own right and has in fact proven to be of even greater generality and broader applicability than just the social, extending to ecology, physics, genetics, computer science, and other domains. This course seeks to teach students the foundations of what has become the new and quite coherent field of network analysis.

Course No.

2592313

Official time

Saturdays, 9.15 - 10.45 & 10.45 - 12.15

Edmodo

All the learning materials (slides, assignments, projects and …) of the course will be uploaded on the official page of the course in Edmodo.

https://edmo.do/j/wm8wse

Objective

The learning objective of the course Social Network Analysis is to provide students with essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks.

Key Outcomes

The key outcomes of the present course for the student are as follows:

- ✓ Be familiar with the basic notation and terminology used in *network science*
- ✓ Be able to *visualize*, *summarize* and *compare networks*
- ✓ Being familiar with how to model the *real-world problems* using the taught tools and concepts
- ✓ Being familiar with how to analyze the networks using *NetworkX package*
- ✓ *Collaborative with peers* to apply these methods to a problem

Pre-requirements

The course is based on basic notions of algebra, mathematics and statistics from undergraduate program. In addition, it might be needed to be familiar with some of the basic concepts in game theory. Having programming skills and experience would be appreciated.

Recommended textbooks

- ✓ Jackson, Matthew O. "*Social and economic networks*. Princeton university press, 2010. (*S&EN*)
- ✓ Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. *Social media mining: an introduction*. Cambridge University Press, 2014. (*SMM*)
- ✓ Chen, Wei, Laks VS Lakshmanan, and Carlos Castillo. *Information and influence propagation in social networks*. Synthesis Lectures on Data Management 5.4 (2013): 1-177. (*IIPSN*)
- ✓ Easley, David, and Jon Kleinberg. *Networks, crowds, and markets*. Vol. 8. Cambridge: Cambridge university press, 2010.
    - *Note: some related papers will be introduced during the course.*

Software and Computing

- ✓ Python
- ✓ Gephi

Grading

- ✓ Final exam: 40%
- ✓ Presentation: 20%
- ✓ Assignments: 20%

- ✓ Project: 20%+20%

Course Syllabus

1. ***Week 1***
   - ***I. Session 1***

     CH 0 - course introduction

   - ***II. Session 2***

     CH 1-What are the networks?
     The importance of Networks and its applications (Ch 1: S&EN)
     i. History
     ii. Classic Problems
     iii. Networks' application in modeling

     Assignment: finding three related articles in terms of SNA applications.

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2. ***Week 2***
   - ***I. Session 1***

     CH 2 -Basic graph and Network concepts (Ch 1: S&EN, Ch 2: SMM, Ch 2: S&EN)
     i. Nodes, Links, Walks, Cycle and …
     ii. Representing Networks

     Presentation: presenting three related articles

   - ***II. Session 2***

     CH 2 -Basic graph and Network concepts (Ch 1: S&EN, Ch 2: SMM, Ch 2: S&EN)
     iii. Special Graphs
     iv. Graph Algorithms (Further Reading)

     Assignment: selecting an article from three funded as the base article, and finding three new articles related to the base article

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3. ***Week 3***
   - ***I. Session 1***

     Discussion about three favorite articles of each student.

     Presentation: presenting three favorite articles.

   - ***II. Session 2***

     CH 3-Network Characteristics
     a. Density (Ch 3, SMM, Ch 2: S&EN)
     b. Degree Distribution (Ch 3, SMM, Ch 2: S&EN)
     c. Diameter and Average Path Length (Ch 3, SMM, Ch 2: S&EN)

     Assignment: finding six new articles related to base article

     Presentation: data gathering methods in the context of SNA

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4. ***Week 4***
   - ***I. Session 1***

CH 3 - Network Characteristics
d. Cliquishness, Clustering (Ch 3, SMM, Ch 2: S&EN)
f. Properties of the Real-Networks (Ch 3: SMM)

II. Session 2

CH 3 - Network Characteristics
e. Homophily (Ch 3, SMM, Ch 2: S&EN)

Assignment: a report of last 10 article, including research issue, used data, and data gathering methods.

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5. Week 5

I. Session 1

CH 4 - Nodes in Networks
a. Centrality Measures (Ch 2: S&EN, Ch 3: SMM)

Presentation: homophily detection algorithms

II. Session 2

CH 4 - Nodes in Networks
a. Centrality Measures (Ch 2: S&EN, Ch 3: SMM)

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6. Week 6

I. Session 1

CH 4 - Nodes in Networks
b. Transitivity and Reciprocity (Ch 2: S&EN, Ch 3: SMM)
c. Similarity (Ch 3: SMM)

Assignment: final report of ten studied articles consist of:

- All past reported details
- All used network measures
- A brief explanation of the methodology
- A table in the style of literature review
- Student's contribution idea

II. Session 2

Centrality Measures in Networks (2017)
Francis Bloch, Matthew O. Jackson, Pietro Tebaldi

Presentation: presenting Centrality Measures in Networks article

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7. Week 7

I. Session 1

Presenting all the final reports

Presentation: Presenting all the final reports

II. Session 2

CH 5- Network Formation
a. Random Models (Ch 4: S&EN)
i. Erdős–Rényi
ii. Poisson
iii. Small-World

iv. Preferential Attachment
v. Properties of Random Networks

Presentation: Presenting all the final reports

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8. Week 8

I. Session 1

introduction to the game theory

Assignment: criticizing other reports

II. Session 2

CH 5- Network Formation
b. Strategic Model (Game Theory) (Ch 6,11: S&EN)

Presentation: presenting the results obtained from criticisms, and they enrichen contribution idea**.**

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9. Week 9

I. Session 1

CH 5- Network Formation
b. Strategic Model (Game Theory) (Ch 6,11: S&EN)

Assignment: complete research proposal

Presentation: presenting the results obtained from criticisms, and they enrichen contribution idea**.**

II. Session 2

Ch 6 - Community Analysis
a. Community Detection (Ch 6: SMM)

Presentation: pajek

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10. Week 10

I. Session 1

Ch 6 - Community Analysis
a. Community Detection (Ch 6: SMM)

Presentation: ucinet

II. Session 2

Ch 6 - Community Analysis
b. Community Evolution (Ch 6: SMM)
c. Community Evaluation (Ch 6: SMM)

Presentation: presenting research proposal

Assignment: progress report

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11. Week 11

I. Session 1

Ch 6 - Community Analysis
b. Community Evolution (Ch 6: SMM)
c. Community Evaluation (Ch 6: SMM)

Presentation: presenting research proposal

II. Session 2

CH 7 - Diffusion on networks
a. Cascade Models (Ch 7: SMM, Ch 7: S&EN, IIPSN)
b. Epidemic Models (Ch 7: SMM, Ch 7: S&EN, IIPSN)

Assignment: progress report

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12. Week 12

I. Session 1

CH 7 - Diffusion on networks
c. Influence Maximization (Ch 7: SMM, Ch 7: S&EN, IIPSN)

II. Session 2

CH 7 - Diffusion on networks
c. Influence Maximization (Ch 7: SMM, Ch 7: S&EN, IIPSN)

Assignment: progress report

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13. Week 13

I. Session 1

CH8 - Special Networks
a. Multilayer
b. Multi-Mode
c. Spatial
d. Temporal

II. Session 2

Applications of SNA
a. Transportation
b. Scientific Collaboration
c. Healthcare
d. Supply Chain management
e. Social Media
f. Labor Markets
g. Terrorism
h. Education management
i. Tourism management

Assignment: progress report

******TA sessions will be Scheduled based on Group Decision***