Syllabus

Social Networks and Group Behavior

Department of Political Science and Department of Sociology

Spring 2023

Instructor:	Hsuan-Wei Lee
Email:	waynelee1217@gmail.com
Time:	Thursdays 15:30 – 17:20
Place:	TBD
Office Hours:	After class or by appointment
Course website:	Ceiba NTU and https://sites.google.com/view/hsuanweilee/teaching

Course Description:

Networks are ubiquitous in our modern society. A social network is a social structure made up of a set of social actors and other social interactions between actors. This course will provide the methods for the study of social networks and group behavior. We will explore both theoretical models and their applications to social, political and economic behavior. Drawing on ideas from economics, sociology, computing and information science, and applied mathematics, it describes the emerging field of study that is growing at the interface of all these areas, addressing fundamental questions about how the social, economic, and technological worlds are connected.

The course begins with an overview of basic backgrounds. We will then cover network properties, strong and weak ties, homophily, positive and negative relationships, games on networks, evolutionary game theory, traffic on networks, auctions, and other topics. One goal of the course is to identify potential research questions for students. By the end of this course, students will have: (1) Broad understanding of social network analysis. (2) Knowledge and tools to analyze social and economic networks. (3) Fundamental understanding of modeling group behavior. (4) The ability to understand research papers in the field of social networks.

The course provides an overview of models and techniques for analyzing social networks and group behavior. The course is meant for undergraduate and graduate students in College of Social Sciences with a good mastery of math/statistics who are interested both in the theoretical study of networks and in their application to political, social and economic phenomena.

Main References: There is the textbook for the course:

- David Easley and Jon Kleinberg.
  Networks, Crowds, and Markets: Reasoning about a Highly Connected World.
  Cambridge University Press, 2010.

Further Readings: Here are some recommended readings. Students are not required to read all of these books prior to class.

- Matthew O. Jackson.
  Social and Economic Networks.
  Princeton University Press, 2008.

- Mark Newman. Networks: An Introduction.
  Oxford University Press, 2010.

- Charles Kadushin. Understanding Social Networks: Theories, Concepts, and Finding.
  Oxford University Press, 2012.

- Nicholas A. Christakis and James H. Fowler. Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives - How Your Friends' Friends' Friends Affect Everything You Feel, Think, and Do.
  Little, Brown and Company, 2011.

Prerequisites: One-semester of calculus, one-year of principles of economics, basic linear algebra, basic probability theory, and applied statistics.

Grading Policy:

Quizzes	10%
Assignments	30%
Midterm	30%
Final Exam	30%

Important Dates:

Midterm	April 13
Final Exam	June 8

Grades:

- Grades in the **C** range represent performance that is **below expectations**;
  Grades in the **B** range represent performance that **meets expectations**;
  Grades in the **A** range represent work that is **excellent**.

Class Policy:

- An important component of this course is active engagement with the material in classes. Regular attendance is essential and expected.

- There will be problem sets every month, with 3-5 questions apiece, drawn mostly from the two text-books. You are encouraged to discuss with your classmates about the problems, but you must write and turn in your own answers. To be blunt, rote copying of an answer from your classmates or other sources is a waste of your time and the grader's time.

- Quizzes and exams are closed book, closed notes.

- No makeup exams will be given.

- No foods in class.

Academic Honesty: Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation.

Class Topics and Readings:

- Week 1

    - Course Overview
    - Reading assignment: Ch. 1

- Week 2

    - Graphs
        * Basic Definitions
        * Paths and Connectivity
        * Distance and Breadth-First Search
        * Network Datasets: An Overview
    - Reading assignment: Ch. 2

- Week 3

    - Strong and Weak Ties
        * Triadic Closure
        * The Strength of Weak Ties
        * Tie Strength and Network Structure in Large-Scale Data
        * Tie Strength, Social Media, and Passive Engagement
        * Closure, Structural Holes, and Social Capital
    - Reading assignment: Ch. 3

- Week 4

    - Networks in Their Surrounding Contexts
        * Homophily
        * Mechanisms Underlying Homophily: Selection and Social Influence
        * Affiliation
        * Tracking Link Formation in On-Line Data
        * A Spatial Model of Segregation
    - Reading assignment: Ch. 4

- Week 5

    - Positive and Negative Relationships
        * Structural Balance
        * Characterizing the Structure of Balanced Networks
        * Applications of Structural Balance
        * A Weaker Form of Structural Balance
    - Reading assignment: Ch. 5

- Week 6

    - Games
        * What is a Game?
        * Reasoning about Behavior in a Game

   * Best Responses and Dominant Strategies
   * Nash Equilibrium
   * Multiple Equilibria: Coordination Games
   * Multiple Equilibria: The Hawk-Dove Game
   * Mixed Strategies
   * Mixed Strategies: Examples and Empirical Analysis
   * Pareto-Optimality and Social Optimality
   - Reading assignment: Ch. 6

- Week 7

  - Evolutionary Game Theory
    * Fitness as a Result of Interaction
    * Evolutionarily Stable Strategies
    * A General Description of Evolutionarily Stable Strategies
    * Evolutionarily Stable Mixed Strategies
  - Reading assignment: Ch. 7

- Week 8

  - Midterm Exam

- Week 9

  - Modeling Network Traffic using Game Theory
    * Traffic at Equilibrium
    * Braess's Paradox
  - Reading assignment: Ch. 8

- Week 10

  - Auctions
    * Types of Auctions
    * When are Auctions Appropriate?
    * Relationships between Different Auction Formats
    * Second-Price Auctions
    * First-Price Auctions and Other Formats
    * Common Values and The Winner's Curse
  - Reading assignment: Ch. 9

- Week 11

  - Information Cascades
    * Following the Crowd
    * A Simple Herding Experiment
    * Bayes' Rule: A Model of Decision-Making Under Uncertainty
    * Bayes' Rule in the Herding Experiment
    * A Simple, General Cascade Model
    * Sequential Decision-Making and Cascades

- – Reading assignment: Ch. 16

- Week 12

  - – Network Effects
    - * The Economy Without Network Effects
    - * The Economy with Network Effects
    - * Stability, Instability, and Tipping Points
    - * A Dynamic View of the Market
    - * Industries with Network Goods
    - * Mixing Individual Effects with Population-Level Effects
  - – Reading assignment: Ch. 17

- Week 13

  - – Power Laws and Rich-Get-Richer Phenomena
    - * Power Laws
    - * Rich-Get-Richer Models
    - * The Unpredictability of Rich-Get-Richer Effects
    - * The Long Tail
    - * The Effect of Search Tools and Recommendation Systems
  - – Reading assignment: Ch. 18

- Week 14

  - – Cascading Behavior in Networks
    - * Diffusion in Networks
    - * Modeling Diffusion through a Network
    - * Cascades and Clusters
    - * Diffusion, Thresholds, and the Role of Weak Ties
    - * Extensions of the Basic Cascade Model
    - * Knowledge, Thresholds, and Collective Action
  - – Reading assignment: Ch. 19

- Week 15

  - – The Small-World Phenomenon
    - * Six Degrees of Separation
    - * Structure and Randomness
    - * Decentralized Search
    - * Empirical Analysis and Generalized Models
    - * Core-Periphery Structures and Difficulties in Decentralized Search
  - – Reading assignment: Ch. 20

- If time allows

  - – Epidemics
    - * Diseases and the Networks that Transmit Them
    - * Branching Processes

* The SIR Epidemic Model
* The SIS Epidemic Model
* Synchronization
* Transient Contacts and the Dangers of Concurrency
* Genealogy, Genetic Inheritance, and Mitochondrial Eve
    – Reading assignment: Ch. 21

- Week 16

    – Final Exam