

Introduction to Social Network Methods

This course provides an introduction to the fundamental structural constructs of social network analysis. The laboratory sessions of the course draw on UCINET 6 for Windows (Analytic Technologies, Version 6.289) to illustrate these constructs on selected network datasets. The focus is on the fundamental terms of the *language* that investigators use in their work on social networks. Thus, as a first step, this course is designed to establish a general basis for an analysis of social network structures that is applicable to a large domain of observed networks. The laboratories serve to make the application of the covered constructs concrete.

Social networks have become an increasingly prominent focus of interest in the social and natural sciences. With this course, students with a passing interest in social networks will see that the assertion “a network exists” is only a start point for various important questions about its structural features and implications. Such students will come away from this course with a substantially more refined perspective and “way of thinking” about social networks. For students who become seriously engaged with social networks, and want to deepen and apply their analytical skills, the crucial next step is further coursework and independent efforts to acquire a facility in some programming language. A facility with UCINET will not suffice to address the questions that are likely to be of interest to you, and UCINET is not necessary to address them. I use the GAUSS (<http://www.aptech.com/>) programming language. However, R (<http://www.r-project.org/>) and, in particular, Mathematica (<http://www.wolfram.com/mathematica/>) are credible alternative languages. Any frustrations that you encounter in learning one of these programming languages will be offset by the substantial long term payoffs of being able to pursue questions about networks with maximum analytical flexibility and personal independence.

Course: Sociology 148MA/248MA, Fall 2011

Lectures: TR, **1304 SSMS**, 2-3:15 (1302 SSMS on 22 Nov)
Laboratory: T, **Miramar Lab, 1526 Phelps Hall** 3:30-4:30

Instructor: Professor Friedkin

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Office hours: W, 3316 SSMS, 9:30-12:00

The course syllabus is on my webpage: <http://www.soc.ucsb.edu/faculty/friedkin>

Course materials (readings and notes) may be downloaded from the hyperlinks on the syllabus.

You must have a flash drive and bring it each laboratory session.

FOUNDATIONS

Week 1: Foundations

- Read: Watts, D.J. and Strogatz, S.H., 1998. "[Collective dynamics of small-world networks.](#)" *Nature* 393, 440-442.
- Tuesday Lecture: [Images of networks](#)
- Tuesday Laboratory: [Introduction to UCINET and NetDraw](#)
- Thursday Lecture: [Foundational graph-analytic constructs, Part I](#) (complete graphs, connectivity, semipaths, paths, walks, geodesics, reachability, distances, flows)

Week 2: Foundations

- Read: Zachary W. (1977). "[An information flow model for conflict and fission in small groups.](#)" *Journal of Anthropological Research*, 33, 452-473
- Tuesday Lecture: [Foundational graph-analytic constructs, Part II](#) (graph connectivity categories, digraph connectivity categories, cuts, disjoint paths, point bases, flows)
- Tuesday Laboratory: [Work on Project 1](#) **Bring a Flash Drive**
- Thursday Lecture: [Foundational graph-analytic constructs, Part III](#) (partitions, strong components, [interfaces](#) and intersections, subgraphs, flows)
- A classic reference for further reading: Harary, Norman and Cartwright (1965) [Structural Models: An Introduction to the Theory of Directed Graphs](#). New York: Wiley.

Project 1 Report (Due Next Tuesday, Oct 11)

ZACHARY KARATE CLUB

DATASET	ZACHARY
DESCRIPTION	Two 34×34 matrices: ZACHE symmetric, binary. ZACHC symmetric, valued.

BACKGROUND These are data collected from the members of a university karate club by Wayne Zachary. The ZACHE matrix represents the presence or absence of ties among the members of the club; the ZACHC matrix indicates the relative strength of the associations (number of situations in and outside the club in which interactions occurred). Zachary (1977) used these data and an information flow model of network conflict resolution to explain the split-up of this group following disputes among the members.

REFERENCE Zachary W. (1977). An information flow model for conflict and fission in small groups. *Journal of Anthropological Research*, 33, 452-473.

NODE CENTRALITY AND INFLUENCE

Week 3: Node Centrality

- Read: Freeman, L. 1978. "[Centrality in social networks: conceptual clarification](#)" *Social Networks* 1 215-239
- Tuesday Lecture: [Freeman's degree, closeness, and betweenness measures](#)
- Tuesday Laboratory: [Work on Project 2](#)
- Thursday Lecture: [Eigenvector measure of node centrality](#)

Week 4: Influence

- Read: Friedkin, N. 1991. "[Theoretical foundations for centrality measures.](#)" *American Journal of Sociology* 96: 1478-1504
- Tuesday Lecture: [Reprise of Zachary's Karate Club Networks](#)
Hubbell & Katz Influence Centralities
- Tuesday Laboratory: [Work on Project 2](#) **Bring a Flash Drive**
- Thursday Lecture: Friedkin & Johnsen Influence Centralities

Project 2 Report (Due Next Tuesday, Oct 25)

GAGNON & MACRAE PRISON

DATASET: PRISON
DESCRIPTION: One 67×67 matrix, non-symmetric, binary.

BACKGROUND: In the 1950s John Gagnon collected sociometric choice data from 67 prison inmates. All were asked, "What fellows on the tier are you closest friends with?" Each was free to choose as few or as many "friends" as he desired. The data were analyzed by MacRae and characterized by him as "less clear cut" in their internal structure than similar data from schools or residential populations.

REFERENCE: MacRae J. (1960). Direct factor analysis of sociometric data. *Sociometry*, 23, 360

COHESIVE SUBGROUPS AND COMMUNITIES

Week 5: Cohesive Subgroups

- Read: Granovetter, M. 1973. "[The strength of weak ties.](#)" *American Journal of Sociology* 78: 1360-1380.
- Tuesday Lecture: [Cliques, 2-cliques, 2-clans, & 2-plexes](#)
- Tuesday Laboratory: [Work on Project 3](#) **Bring a Flash Drive**
- Thursday Lecture: [Measures of Node Proximities and Distances](#)

Week 6: Communities

- Read: Ball, B., B. Karrer and M. Newman. "[An efficient and principled method for detecting communities in networks.](#)" *Phys. Review E.*, in press.
- Tuesday Lecture: Reprise of the Prison Network
[Hierarchical Cluster Analysis](#)
- Tuesday Laboratory: [Work on Project 3](#) **Bring a Flash Drive**
- Thursday Lecture: [Affiliation Matrices](#)

Project 3 Report (Due Next Tuesday, Nov 8)

Revisiting the ZACHARY KARATE CLUB

(note that this network is analyzed in the Ball, Karrer and Newman, in press, publication)

DATASET	ZACHARY_
DESCRIPTION	Two 34×34 matrices: ZACHE symmetric, binary. ZACHC symmetric, valued.

BACKGROUND These are data collected from the members of a university karate club by Wayne Zachary. The ZACHE matrix represents the presence or absence of ties among the members of the club; the ZACHC matrix indicates the relative strength of the associations (number of situations in and outside the club in which interactions occurred). Zachary (1977) used these data and an information flow model of network conflict resolution to explain the split-up of this group following disputes among the members.

REFERENCE Zachary W. (1977). "[An information flow model for conflict and fission in small groups.](#)" *Journal of Anthropological Research*, 33, 452-473.

ALIGNMENTS OF RELATIONS

Week 7: Aligned Relational Positions

<u>Read:</u>	Read K. 1954. " Cultures of the central highlands, New Guinea. " <i>Southwestern Journal of Anthropology</i> , 10, 1-43.
<u>Tuesday Lecture:</u>	Structural Equivalence of Relational Profiles and Hierarchical Clustering
<u>Tuesday Laboratory:</u>	Work on Project 4 Bring a Flash Drive
<u>Thursday Lecture:</u>	Blockmodels

Week 8 Balanced Alignments

<u>Read:</u>	White H., S. Boorman and R. Breiger. 1976. " Social structure from multiple networks. I. Blockmodels of Roles and Positions. " <i>American Journal of Sociology</i> 81: 730-780.
<u>Tuesday Lecture:</u>	Generalized Balance Theory
<u>Tuesday Laboratory:</u>	Work on Project 4 Bring a Flash Drive
<u>Thursday Lecture:</u>	Blockmodels of Generalized Balance Theory

Project 4 Report (Due Next Tuesday, Nov 22)

READ HIGHLAND TRIBES DATASET GAMA

DESCRIPTION Two 16×16 matrices

GAMAPOS symmetric, binary
GAMANEG symmetric, binary.

BACKGROUND Hage & Harary (1983) use the Gahuku-Gama system of the Eastern Central Highlands of New Guinea, described by Read (1954), to illustrate a clusterable signed graph. Read's ethnography portrayed an alliance structure among three tribal groups containing balance as a special case; among Gahuku-Gama the enemy of an enemy can be either a friend or an enemy.

The signed graph has been split into two matrices: GAMAPOS for alliance ("rova") relations, GAMANEG for antagonistic ("hina") relations. To reconstruct the signed graph, multiply GAMANEG by -1, and add the two matrices.

REFERENCES Hage P. and Harary F. (1983). *Structural models in anthropology*. Cambridge: Cambridge University Press (See p 56-60); Read K. (1954). *Cultures of the central highlands, New Guinea*. *Southwestern Journal of Anthropology*, 10, 1-43.

TWO RESEARCH FRONTIERS

(and an introduction to my recent work)

Week 9 Research on Processes Unfolding in Social Networks

Read: Childress, C. and N. Friedkin. "[Cultural reception and production: The social construction of meaning in book clubs.](#)" *American Sociological Review*, in press; and Friedkin, N. 2010. "[The attitude-behavior linkage in behavioral cascades.](#)" *Social Psychology Quarterly* 73: 196-213.

Tuesday Lecture: The paradigm shift towards social process models (**SSMS 1302**)

Tuesday Laboratory: Illustration of the employment of a programming language (**SSMS 1304**)

Thursday Lecture: Holiday

Week 10: Research on the Evolution of Social Networks

Read: Friedkin, N. "[A formal theory of reflected appraisals in the evolution of power.](#)" *Administrative Science Quarterly*, in press.

Tuesday Lecture: Longitudinal research on node and edge labeled social networks

Tuesday Laboratory: **Graduate students only**

Thursday Lecture: Contours of Social Network Theory and Application

[Project 5 Report](#) (Due Next Tuesday, Dec 6)