

**NORTHWESTERN UNIVERSITY**

**Social Network Analysis**

**Winter 2008, Wednesdays 6 – 9 pm, Technological Institute LR4**

**IEMS 490-0-21 LEC (26025) Selected Topics in Industrial Engineering**

**COMM\_ST 525-0 – 21 LEC (26744) Seminar-Problems in Communication Studies**

**Office hours: 3-6 pm Wednesday or by appointment**

**Contact info: 847-491-3669, D241 TECH, nosh@northwestern.edu**

Over the past two decades networks have come to play an increasingly important role in our understanding of a wide array of human phenomena. In communication and the organizational sciences, extraordinary developments in computing and telecommunications have engendered new organizational forms based on fluid, dynamic networks. These new network forms of self-organizing are constantly evolving in dynamic communities as new network links are created, and dysfunctional ones dissolved. While many writers assert that the capability to nurture networks will differentiate dominant 21st century organizations, little is known about how this important new organizational form emerges and evolves

This seminar is intended to review theoretical, conceptual, and analytic issues associated with network perspectives on communicating and organizing. The course will review scholarship on the science of networks in communication, computer science, economics, engineering, organizational science, life sciences, physical sciences, political science, psychology, and sociology, in order to take an in-depth look at theories, methods, and tools to examine the structure and dynamics of networks.

As with most graduate seminars, the majority of class time will be spent discussing the assigned readings. A series of laboratory exercises will provide experience with computer-based network analysis, modeling and visualization tools. Students will write a term paper advancing some theoretical, methodological or computational aspect of network science.

***The following texts will be assigned for this course. The following texts will be assigned for this course.***

Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside (published in digital form at <http://faculty.ucr.edu/~hanneman/> )

Monge, P. R., & Contractor, N. S. (2003). *Theories of communication networks*. New York: Oxford University Press.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press.

***Please plan to purchase the Monge & Contractor and Wasserman & Faust texts from your favorite online or brick-and-mortar store.***

Additional assigned readings will be available on the course web site. The password is: nosh

***The following software tools will be introduced in the course:***

**Netlogo:** Wilensky, U. (2007). NetLogo. <http://ccl.northwestern.edu/netlogo>. Center for Connected Learning and Computer-Based Modeling. Northwestern University, Evanston, IL. <http://ccl.northwestern.edu/netlogo/>

**Pajek:** Vladimir Batagelj & Andrej Mrvar (2007): Pajek - Analysis and Visualization of Large Networks. <http://vlado.fmf.uni-lj.si/pub/networks/pajek/>

**Pnet:** (Wang, P. Robins, G. & Pattison, P. 2007). Software that includes procedures for MCMCMLE for exponential random graph models – University of Melbourne, Australia.

<http://www.sna.unimelb.edu.au/pnet/pnet.html>

**SIENA:** Snijders, T.A.B., Steglich, C. E. G., Schweinberger, M. & Huisman, M. (2007). *SIENA: Simulation Investigation for Empirical Network Analysis*. University of Groningen: ICS / Department of Sociology; University of Oxford: Department of Statistics, (<http://stat.gamma.rug.nl/siena.html>)

**StatNet:** Handcock, M. S., Hunter, D. R., Butts, C. T., Goodreau, S. M., and Morris, M. (2007) *Statnet: An R package for the Statistical Modeling of Social Networks*. Funding support from NIH grants R01DA012831 and R01HD041877. URL <http://www.csde.washington.edu/statnet>.

**UCINET:** Borgatti, S., Everett, M., & Freeman, L. (2005) UCINET 6 for Windows software for social network analysis. Harvard, MA: Analytic Technologies. <http://www.analytictech.com>

### Expectations & Evaluation

There are three requirements for the course: four network labs, one term paper, and online participation. The four network labs will require you to conduct computational analyses on network data. Equal emphasis will be given to conducting the analysis and interpreting (and reporting) the results. The lab assignments due dates are shown below. You are free to revise these reports as often as you wish before March 19<sup>th</sup> for full credit.

The term paper should develop or elaborate a theory, method or application of your choice, explicitly incorporating a network perspective. It should review the relevant research literature and include a research design that tests network hypotheses or makes novel methodological or computational contributions. Papers need to be prepared according to the guidelines specified in the *Publication Manual of the American Psychological Association* (5<sup>th</sup> ed.), or the guidelines for a specific journal of your choosing. You are free to use this as an opportunity to develop a working paper or dissertation proposal or to develop ideas you have worked on in other courses. The term paper is due on March 19<sup>th</sup>.

The online participation is an opportunity for you to provide substantive reactions to the readings for the week. These reactions should be posted online no later than 24 hours prior to the start of class (that is, by Tuesdays at 5 pm). The reactions could include key takeaways from, extensions of, challenges to, and/or disagreements with the ideas developed in the readings. Your contribution will be evaluated on the quality of the reactions and their coverage of the breadth of readings for each session.

Your final grade will be allocated between the two requirements as follows:

Network Labs:	40% (10% each)
Online participation	27% (3% each)
Term Paper	33%

## Course Outline

### Date      Activity

#### **Jan 9      Introduction to Networks**

#### **Jan 16      Network Concepts & Measures I**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 1. Available online at: <http://nosh.northwestern.edu/vita.html#Pub>

Monge, P.R., & Contractor, N. (1988). Communication networks: Measurement techniques. In C.H. Tardy (Ed.), *A handbook for the study of human communication* (pp. 107-138). Norwood, NJ: Ablex. Available online at: <http://nosh.northwestern.edu/bookchapters/Monge-1988.pdf> (password: nosh)

Hanneman, R. A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapters 1-3, 5. Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

Watts, D. J. (2004). The "new" science of networks. *Annual Review of Sociology* 30(1), 243-270. <http://www.iknowinc.com/~nosh/Watts-2004.pdf> (password: nosh)

#### *Optional:*

Wasserman, S., & Faust, K. (1994) *Social network analysis: Methods and applications*. New York: Cambridge University Press.

Cp. 1, Social Network Analysis in the Social and Behavioral Sciences. Available online at: [http://sonic.northwestern.edu/Digital-Readings/Wasserman&Faust\\_1994a.pdf](http://sonic.northwestern.edu/Digital-Readings/Wasserman&Faust_1994a.pdf) (password: nosh)

Cp. 2, Social Network Data: Collection and Applications. Available online at:

[http://sonic.northwestern.edu/Digital-Readings/Wasserman&Faust\\_1994b.pdf](http://sonic.northwestern.edu/Digital-Readings/Wasserman&Faust_1994b.pdf) (password: nosh)

#### **Jan 23.      Network Concepts & Measures II**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 2. <http://nosh.northwestern.edu/vita.html#Pub>

Hanneman, R. A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapters 6-10. Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

Krebs, V. E. (2002). Mapping networks of terrorists cells. *Connections*, 24(3), 43-52. Available online at: <http://www.insna.org/Connections-Web/Volume24-3/Valdis.Krebs.web.pdf>

Adamic, L. A. & Glance, N. (2005). The Political Blogosphere and the 2004 U.S. Election: Divided They Blog, LinkKDD-2005, Chicago, IL, Aug 21, 2005. Available online at: <http://www.hpl.hp.com/research/idl/papers/politicalblogs/AdamicGlanceBlogWWW.pdf>

Kapucu, N. (2005). "Interorganizational Coordination in Dynamic Context: Networks in Emergency Response Management." *Connections* 26(2): 35-50. Available online at: <http://insna.org/Connections-Web/Volume26-2/4.Kapucu.pdf>

*Optional:*

Wasserman, S., & Faust, K. (1994) *Social network analysis: Methods and applications*. New York: Cambridge University Press. Cp. 3, Notation for Social Network Data and Cp. 4: Graphs and Matrices

### **Network Lab 1: Density & Centrality (Due Jan 30)**

#### **Jan 30 Network Concepts & Measures III**

Hanneman, R. A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapters 11,12,16,17. Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

Krackhardt, D. (1988). Predicting with networks: Nonparametric multiple regression analysis of dyadic data. *Social Networks*, 10, 359-381 <http://sonic.northwestern.edu/digital-readings/Krackhardt%201988.pdf>

Krackhardt, D. (1987). Cognitive social structures. *Social Networks*, 9, 109-134.

<http://sonic.northwestern.edu/digital-readings/Krackhardt%201987.pdf>

*Optional:*

Wasserman, S., & Faust, K. (1994) *Social network analysis: Methods and applications*. New York: Cambridge University Press. Cp. 5, Centrality and Prestige

### **Network Lab 2, QAP, CSS & Structural Equivalence (Due Feb 6)**

#### **Feb 6 Testing MTML hypotheses using ERGM/p\***

Contractor, N., Wasserman, S., & Faust, K. (2006). Testing multi-theoretical multilevel hypotheses about organizational networks: An analytic framework and empirical example. *Academy of Management Review*, 31, 681-703.

<http://sonic.northwestern.edu/digital-readings/Contractor,%20Wasserman,%20Faust%202006.pdf>

Robins, G., Pattison, P. & Woolcock, J. (2005). Small and other worlds: Global network structures from local processes. *American Journal of Sociology*, 110, 4, 894-936. <http://sonic.northwestern.edu/digital-readings/Robins%20et%20al%202005.pdf>

Goodreau, S. M. (2007). Advances in exponential random graph ( $p^*$ ) models applied to a large social network. *Social Networks*, 28, 231-248.

<http://sonic.northwestern.edu/digital-readings/Goodreau%202007.pdf>

Robins, G., Snijders, T., Wang, P., Handcock, M., & Pattison, P. (2007). Recent developments in exponential random graph ( $p^*$ ) models for social networks. *Social Networks*, 29, 192-215.

<http://sonic.northwestern.edu/Digital-Readings/Robins%20et%20al%202007.pdf>

*Optional:*

Monge, P. R., & Matei, S. A. (2004). The role of the global telecommunications network in bridging economic and political divides, 1989 to 1999. *Journal of Communication*, 54, 511-531.

[http://sonic.northwestern.edu/Digital-Readings/Monge%20%26%20Matei%202004\\_Global%20telecomm.pdf](http://sonic.northwestern.edu/Digital-Readings/Monge%20%26%20Matei%202004_Global%20telecomm.pdf)

Shumate, M.D. & Dewitt, L. (2008). The North/South Divide in NGO Hyperlink Networks. *Journal of Computer-Mediated Communication*.

<http://sonic.northwestern.edu/Digital-Readings/Shumate%20%26%20Dewitt%202008.pdf>

### Network Lab 3: ERGM (Due Feb 13)

#### **Feb 13: Generating & Testing hypotheses about Network Dynamics**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 4. <http://nosh.northwestern.edu/vita.html#Pub>

Macy, M. W. & Willer, R. (2002). From factors to actors: Computational sociology and agent-based modeling. *Annual Review of Sociology* 28(1), 143-166.  
<http://sonic.northwestern.edu/digital-readings/macy.pdf>

Cederman, L.-E. (2005). Computational Models of Social Forms: Advancing Generative Process Theory. *American Journal of Sociology* 110(4), 864-893. <http://sonic.northwestern.edu/digital-readings/Cederman%202005.pdf>

Palazzolo, E. T., Serb, D., She, Y., Su, C., & Contractor, N. S. (2006). Co-evolution of communication and knowledge networks as Transactive Memory systems: Using computational models for theoretical integration and extensions. *Communication Theory*. 16, 223-250. <http://sonic.northwestern.edu/digital-readings/Palazzolo%20et%20a%202006.pdf>

Steglich, C., Snijders, T., West, P. (2006). Applying SIENA: An illustrative analysis of the co-evolution of adolescents' friendship networks, taste in music, and alcohol consumption. *Methodology*, 2(1), 48-56. <http://sonic.northwestern.edu/Digital-Readings/Steglich%20et%20a%202006.pdf>

Pearson, M., Steglich, C., & Snijders, T. (2006) Homophily and assimilation among sport-active adolescent substance users. *Connections*, 27(1), 47-63. Available online at: <http://www.insna.org/Connections-Web/Volume27-1/7.Pearson.pdf>

*Optional:*

Moody, J., McFarland, D., Bender-deMoll, S. (2005). Dynamic Network Visualization1. *The American Journal of Sociology*, 110(4), 1206-43. <http://sonic.northwestern.edu/digital-readings/AJS2005.proof.pdf>

Powell, W. W., D. R. White, et al. (2005). "Network Dynamics and Field Evolution: The Growth of Interorganizational Collaboration in the Life Sciences." *American Journal of Sociology* 110(4): 1132-1206. <http://sonic.northwestern.edu/digital-readings/powell%20et%20a%202005.pdf>

### Network Lab 4: SIENA (Due Feb 20)

#### **Feb 20 Network Formulations of Theories of Self-interest & Collective Interest**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 5. <http://nosh.northwestern.edu/vita.html#Pub>

Hanneman, R A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapter 9. Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

Burt, R. S. (2005) The Social Capital of Structural Holes. Cp. 1 in *Brokerage and Closure: An Introduction to Social Capital*, pp. 10-57. <http://sonic.northwestern.edu/digital-readings/BurtChapter1.pdf>

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42, 35-67. <http://sonic.northwestern.edu/digital-readings/uzzi1997.pdf>

Marwell, G., P. E. Oliver, et al. (1988). Social Networks and Collective Action: A Theory of the Critical Mass. III. *The American Journal of Sociology* 94(3), 502-534. <http://sonic.northwestern.edu/digital-readings/marwell88.pdf>

Diani, M. (2003). Introduction: Social Movements, contentious actions, and social networks: From metaphor to substance? In M. Diani & D. McAdam (Eds.), *Social Movement and Networks: Relational Approaches to Collective Action* (pp. 1-20). Oxford, UK: Oxford University Press. <http://sonic.northwestern.edu/digital-readings/Diani%202003.pdf>

Passy, F. (2003). Social networks matter. But how? In M. Diani & D. McAdam (Eds.), *Social Movement and Networks: Relational Approaches to Collective Action* (pp. 21-48). Oxford, UK: Oxford University Press. <http://sonic.northwestern.edu/digital-readings/Passy%202003.pdf>

### **Research Paper topic proposal due Feb 27**

#### **Feb 27 Network Formulations of Theories of Contagion**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 6. <http://nosh.northwestern.edu/vita.html#Pub>

Reagans, R. and B. McEvily (2003). Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly* 48(2), 240-267. <http://sonic.northwestern.edu/Digital-Readings/reagans%20and%20mcevil%202003.pdf>

Newman, M. E. J. & Girvan, M. (2004). Finding and evaluating community structure in networks. *Physical Review E* 69(2), 26113. <http://sonic.northwestern.edu/digital-readings/Newman%202004.pdf>

Bearman, P., Moody, J., & Stovel, K. (2004). Chains of affection: The structure of adolescent romantic and sexual networks. *American Journal of Sociology*, 110 (1), 44-91. <http://sonic.northwestern.edu/digital-readings/Bearman%20et%20al%202004.pdf>

Leonardi, P. M. (2007). Activating the Informational Capabilities of Information Technology for Organizational Change. *Organization Science* 18(5), 813-831. <http://sonic.northwestern.edu/digital-readings/Leonardi%202007.pdf>

*Optional:*

Wasserman, S., & Faust, K. (1994) *Social network analysis: Methods and applications*. Cp. 6: Structural Balance and Transitivity and Cp. 7: Cohesive subgroups. Cp. 8: Affiliations and Overlapping Subgroups. Cp. 9: Structural Equivalence. New York: Cambridge University Press.

#### **Mar 5: Network Formulations of Homophily, Proximity, & Social Support**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 8. <http://nosh.northwestern.edu/vita.html#Pub>

Ruef, M., Aldrich, H. A., & Carter, N. M. (2003). The structure of founding teams: Homophily, strong ties, and isolation among U.S. entrepreneurs. *American Sociological Review*, 68, 195-222.  
<http://sonic.northwestern.edu/digital-readings/Ruef%20et%20al%202003.pdf>

Bell, G. G. & A. Zaheer, A. (2007). Geography, Networks, and Knowledge Flow. *Organization Science*, 18, 955-972. <http://sonic.northwestern.edu/digital-readings/Bell%20%26%20Zaheer%202007.pdf>

Hampton, K. & Wellman, B. (2001). Long Distance Community in the Network Society: Contact and Support Beyond Netville." *American Behavioral Scientist*, 45 3, 477-496 <http://sonic.northwestern.edu/digital-readings/Hampton%20%26%20Wellman%202001.pdf>

**Mar 12: Network Formulations of Theories of Exchange and Dependency Theories**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 7. <http://nosh.northwestern.edu/vita.html#Pub>

McGinn, K.L., & Keros, A.T. (2002). Improvisation and the logic of exchange in socially embedded transactions. *Administrative Science Quarterly*, 47, 442-473. <http://sonic.northwestern.edu/Digital-Readings/McGinn%20%26%20Keros%202002.pdf>

Gulati, R., Higgins, M.C. (2003). Which ties matter when? The contingent effects of interorganizational partnerships on IPO success. *Strategic Management Journal*, 24(2), 127-144  
<http://sonic.northwestern.edu/digital-readings/Gulati%20%26%20Higgins%202003.pdf>

Guimera, R., Uzzi, B., Spiro, J., Amaral, L.A.N. (2005). Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance, *Science*, 308, 697-702.  
<http://sonic.northwestern.edu/digital-readings/Guimera%20et%20al%202005.pdf>

**Mar 19: Final Research Paper due**