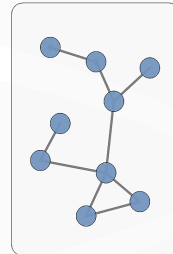
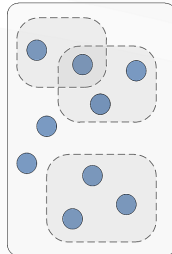
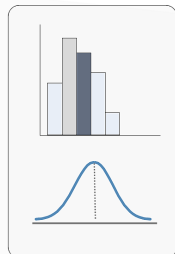


Fall 2012

## Annenberg School of Communication



### COMM 645: SEMINAR IN COMMUNICATION NETWORKS

COMM 645: Seminar in Communication Networks

Wednesdays, 2:00 to 4:50PM, ASC 240

Professor Peter Monge

Office Hours: Wednesdays, 1:00 – 2:00PM

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Over the past few 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 21st century organizations from their predecessors, 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 across a wide array of disciplines 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. Students will write a term paper advancing and empirically testing some theoretical, methodological, or substantive aspect of communication networks.

### **Assigned Texts for the 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.

Additional assigned readings will be available on the course web site.

### **Software tools that will be introduced in the course:**

**NodeXL:** Smith, M., Milic-Frayling, N., Shneiderman, B., Capone, T., Mendes Rodrigues, E., Leskovec, J., Dunne, C. (2012) Network Overview, Discovery and Exploration Add-In for Microsoft Excel. <http://nodexl.codeplex.com>

**PNet:** Wang, P. Robins, G. & Pattison, P. 2012. Software that includes procedures for MCMC MLE 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. (2012). SIENA: *Simulation Investigation for Empirical Network Analysis*. University of Groningen: ICS / Department of Sociology; University of Oxford: Department of Statistics, <http://www.stats.ox.ac.uk/~snijders/siena>

**Statnet:** Handcock, M. S., Hunter, D. R., Butts, C. T., Goodreau, S. M., and Morris, M. (2012) Statnet: *An R package for the Statistical Modeling of Social Networks*. Funding support from NIH grants R01DA012831 and R01HD041877. <http://www.csde.washington.edu/statnet>.

**UCINET:** Borgatti, S., Everett, M., & Freeman, L. (2012) UCINET 6.415 for Windows software for social network analysis. Harvard, MA: Analytic Technologies. <http://www.analytictech.com>, <http://sites.google.com/site/ucinetsoftware>

Other software available:

**Gephi:** Bastian, M. (2012) An open graph visualization platform. The Gephi Consortium. <http://gephi.org>, <http://consortium.gephi.org>

**Netlogo:** Wilensky, U. (2012). NetLogo 5. Center for Connected Learning and Computer-Based Modeling. Northwestern University, Evanston, IL. <http://ccl.northwestern.edu/netlogo>

**Pajek:** Vladimir Batagelj & Andrej Mrvar (2012): Pajek – Analysis and Visualization of Large Networks. <http://pajek.imfm.si/doku.php>

### **Expectations & Evaluation**

There are two requirements for the course: ten network labs and one term paper. The 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 are due by class time of the week after they are assigned. Labs submitted after that date will receive a maximum of half credit. All labs must be completed correctly in order to receive a grade for the class. If you do not get full points on a lab, please revise it within a week of receiving your score.

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 theory, research literature and include a research design that tests network hypotheses or makes novel methodological or computational contributions. Original data are preferred, but secondary data are acceptable. Papers need to be prepared according to the guidelines specified in the *Publication Manual of the American Psychological Association* (6<sup>th</sup> ed.). You can also prepare your work according to the guidelines for a specific journal of your choosing, though you should work out of the APA guidelines first, and then adapt your paper after you have met all APA Guidelines. You are free to use this assignment as an opportunity to develop a working paper, dissertation proposal, or conference paper or to develop ideas you have worked on in other courses. If the latter, be sure to discuss with us the overlap with previous work and the anticipated extension. The term paper is due on Monday, December 10th. Your final grade will be calculated as follows:

Network Labs (10):	40% (4% each)
Term Paper:	60%
Total	100%

## Academic Integrity

The School of Communication is committed to the highest standards of ethical conduct and academic excellence. Any student found guilty of plagiarism, fabrication, cheating on examinations, purchasing papers or other assignments, or any other form of academic dishonesty will receive a failing grade in the course from the instructor and the School will recommend that the student be dismissed from the Communication program. There are no exceptions to this policy.

## Course Outline

### Date      Activity

#### **Aug. 29: Introduction to the Communication Networks Class**

#### **Sept. 5: Network Theory, Concepts & Measures I (Nodes, Relations, Network Articulation & Roles, One & Two Mode Networks, Density, Centrality, Issues in network measurement)**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks* (TCN). New York: Oxford University Press. Chapter 1

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.

Balkundi, P., Kilduff, M., & Harrison, D. A. (2011). Centrality and charisma: Comparing how leader networks and attributions affect team performance. *The Journal of Applied Psychology*.

Valente, T. W. (2010). *Social Networks and Health: Models, Methods, and Applications*. New York, NY: Oxford University Press. Ch. 3: Methods (Data Collection Techniques, Data Management, Data Characteristics, Network Variables)

#### Optional reading:

Campbell, K. E. & Lee, B. A. (1991). "Name generators in surveys of personal networks." *Social Networks*, 13: 203-221.

***Lab 1: Network data formats and representations including matrices, node lists, link lists, and matrix algebra.*** (Due Sept. 12.)

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press. Cps. 1 & 2.

Hanneman, R A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapters 1-6.  
Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

Optional reading:

Easley, D., & Kleinberg, J. (2010). Graphs. In D. Easley & J. Kleinberg, *Networks, Crowds, and Markets*. Cp. 2.

**Sept. 12: Network Concepts & Measures II (Density, connectivity, distance, reciprocity, transitivity, clustering, centralization)**

Hanneman, R. A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapters 7-10.  
Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

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

Lee, S., Monge, P. R., Bar, F., Matei, S. (2007). The emergence of clusters in global telecommunications networks. *Journal of Communication*. 57, 415-434.

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.

Krebs, V. E. (2002). Mapping networks of terrorists cells. *Connections*, 24(3), 43-52.

Powell, W. (1990). "Neither Market Nor Hierarchy: Network Forms of Organization." *Research in Organizational Behavior*, 12: 295-336.

Optional reading:

Borgatti, S.P. & Foster, P. (2003). "The network paradigm in organizational research: A review and typology." *Journal of Management*. 29(6), 991-1013.

Faust, K. (1997). "Centrality in Affiliation Networks." *Social Networks*, 19: 157-191.

***Lab 2: Computing Network and Node Level Measures with UCINET: Density, Degree, Reciprocity, Transitivity, Centralization, Clustering*** (Due Sept. 19)

Freeman, L. C. (1979). Centrality in social networks conceptual clarification. *Social Networks*, 1(3), 215-239.

**Sept. 19: Multitheoretical MultiLevel (MTML) + MultiDimensional Models (MTML+MD Models)**

Monge & Contractor (2003), Cp. 2.

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.

Contractor, N., Monge, P., & Leonardi, P. (2011, Apr 8). Network theory | Multidimensional networks and the dynamics of sociomateriality: Bringing technology inside the network. *International Journal of Communication* [Online] 5:0. Available: <http://ijoc.org/ojs/index.php/ijoc/article/view/1131>

Lee, S. & Monge, P. (2011). The coevolution of multiplex networks in organizational communities. *Journal of Communication*, 61, 758-779.

Ognyanova, K. & Monge, P. (in press) A Multitheoretical, Multilevel, Multidimensional Network Model of the Media System: Production, Content, and Audiences. *Communication Yearbook*.

***Lab 3: Subgroups and Structural Equivalence*** (Due Sept. 26).

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

Wasserman S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press. Cps. 7-9

**Sept. 26: Theories of Self-Interest and Collective Action (Social Capital, Transaction Cost Economics, and Public Goods)**

Monge and Contractor (2003), Cp. 5.

Burt, R. S. (2005) The Social Capital of Structural Holes. Cp. 1 in *Brokerage and Closure: An Introduction to Social Capital*, pp. 10-57.

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.

Shen, C., Monge, P., & Williams, D. (2012). Virtual brokerage and closure: Network structure and social capital in a massively multiplayer online game. *Communication Research*, 39(4), 1-21.

***Lab 4: Introduction to R including data input, formatting, processing, and simple operations.*** (Due Oct. 3)

Venables, W. N., Smith, D. M. (2011) *An Introduction to R*.  
Ch. 1-7, pp.1-35.

Optional reading:

Paradis, E. (2005). *R for Beginners*.

### **Oct. 3: Evolutionary and Ecological Theories**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*.  
New York: Oxford University Press. Chapter 9.

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.

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.

Monge, P.R., Heise, B.R., & Margolin, D. (2008). Communication network evolution in organizational communities. *Communication Theory*, 18, 449-477.

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.

**Research Paper topic proposal due.**

***Lab 5: Network Measures and hypothesis testing in R, The Statnet package, and the iGraph package.*** (Due Oct. 10).

Skim through the package manuals for SNA and iGraph:

Butts, C. T. (2012) 'SNA' Manual

Csardi, G. (2012) Package 'igraph'

## **Oct. 10: Contagion, Semantic and Cognitive Theories (Including Transactive Memory)**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapters 3 & 6.

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.

Burt, R.S. (1987). "Social Contagion and Innovation: Cohesion Versus Structural Equivalence." *American Journal of Sociology*, 92: 1287-1335.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine*, 357(4), 370-379. (or smoking, or happiness)

### ***Lab 6: Cognitive Social Structures and Quadratic Assignment Procedures (QAP & MRQAP)*** (Due: Oct. 17)

Hanneman, R. A. & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside. Chapter 18. Available online at: <http://faculty.ucr.edu/~hanneman/nettext/index.html>

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

Krackhardt, D. (1988). Predicting with networks: Nonparametric multiple regression analysis of dyadic data. *Social Networks*, 10, 359-381

## **Oct. 17: Exchange and Dependency Theories**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 7.

McGinn, K.L., & Keros, A.T. (2002). Improvisation and the logic of exchange in socially embedded transactions. *Administrative Science Quarterly*, 47, 442-473.

Shumate, M., & Palazzolo, E. T. (2010). Exponential Random Graph (p\*) Models as a Method for Social Network Analysis in Communication Research. *Communication Methods and Measures*, 4(4), 341-371.



Harrigan, N. (2009). Exponential Random Graph (ERG) models and their application to the study of corporate elites. Center for research methods in the social sciences.

***Lab 7: Exponential Random Graph Models (ERGMs) in R and PNet.*** (Due Oct 24)

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.

Hunter, D. R., Handcock, M. S., Butts, C. T., Goodreau, S. M., & Morris, M. (2008). ergm: A package to fit, simulate and diagnose exponential-family models for networks. *Journal of Statistical Software*, 24(3).

Optional reading:

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

Introduction to Exponential-family Random Graph (ERG or  $p^*$ ) modeling with Statnet – Butts et al Sunbelt Handout available at:  
<http://csde.washington.edu/statnet/Resources/Sunbelt2012/ERGM/ERGMtutorial.pdf>

Robins, G., Pattison, P., Kalish, Y., & Lusher, D. (2007). “An introduction to exponential random graph ( $p^*$ ) models for social networks.” *Social Networks*, 29(2): 173-191.

**Oct. 24: Network Formulations of Homophily, Proximity, & Social Support**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 8.

McPherson, M., Smith-Lovin, L., Cook, J.M. (2001) “Birds of a Feather: Homophily in Social Networks.” *Annual Review of Sociology*, 27: 415-444.

Hampton, K.N., Livio, O., & Sessions, L. (2010). “The Social Life of Wireless Urban Spaces: Internet Use, Social Networks, and the Public Realm.” *Journal of Communication*, 60(4): 701-722.

Takhteyev, Y., Gruzd, A., & Wellman, B. (2011). Geography of Twitter networks. *Social Networks*.

Macy, M. W. & Willer, R. (2002). From factors to actors: Computational sociology and agent-based modeling. *Annual Review of Sociology* 28(1), 143-166.

**Lab 8: Network dynamics and actor based modeling with RSiena.** (Due Oct. 31).

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/PDF/Connections/v27/2006\\_I-1-7.pdf](http://www.insna.org/PDF/Connections/v27/2006_I-1-7.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.

Optional reading:

Snijders, T. A. B., Van de Bunt, G. G., & Steglich, C. E. G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, 32(1), 44-60.

Ripley, R. M., Snijders, T. A. B., Preciado, P. (2012) *Manual for RSiena*.

**Oct. 31: The New Science of Networks.**

Monge, P. R., & Contractor, N. (2003). *Theories of Communication Networks*. New York: Oxford University Press. Chapter 10.

Watts, D. J. (2004). The "new" science of networks. *Annual Review of Sociology* 30(1), 243-270.

Easley, D., & Kleinberg, J. (2010). Power laws and rich-get-richer phenomena. In D. Easley & J. Kleinberg, *Networks, Crowds, and Markets*. Cp. 18

Barabasi, A. & Albert, R. (1999). "Emergence of Scaling in Random Networks." *Science*, 286: 509-512.

**Lab 9: Network Visualization with R, Gephi, NodeXL, Visone.** (Due Nov 7)

Moody, J., McFarland, D., Bender-deMoll, S. (2005). Dynamic Network Visualization. *The American Journal of Sociology*, 110(4), 1206-43.

Scott, J., & Carrington, P. (Eds.). (2011). *The Sage Handbook of Social Network Analysis*. Thousand Oaks, CA: Sage Publications.  
Ch. 37 Network Visualization

Optional reading:

Freeman, L. C. (2000). Visualizing social networks. *Journal of Social Structure*, 1(1), 4.

Hansen, D., Shneiderman, B., & Smith, M. A. (2010). Analyzing social media networks with NodeXL. Burlington, MA: Morgan Kaufmann  
Ch. 5 Calculating and Visualizing Network Metrics

### **Nov. 7: Analyzing the Web**

Easley, D., & Kleinberg, J. (2010). Link analysis and web search. In D. Easley & J. Kleinberg, *Networks, Crowds, and Markets*, Cp. 14.

Weber, M. & Monge, P. R. (2011). The flow of digital news in a network of sources, authorities, and hubs. *Journal of Communication*, 61, 1062-1081.

Ackland, R. (2012) *Concepts, Data and Tools for Social Scientists in the Digital Age*. Ch.4 Hyperlink Networks

#### **Optional reading:**

Turow, J., & Tsui, L. (Eds.). (2008). *The Hyperlinked Society: Questioning Connections in the Digital Age*. Ann Arbor, MI: University of Michigan Press.  
Available at <http://www.digitalculture.org/books/hyperlinked-society>

### ***Lab 10: Collecting and Analyzing Twitter & Facebook data with NodeXL*** (Due Nov. 28)

Fielding, N. (Ed.). (2008). *The Sage Handbook of Online Research Methods*. Thousand Oaks, CA: Sage Publications. Ch.8 Analyzing Social Networks Via the Internet – Bernie Hogan

### **Nov. 14: NCA Conference**

No Class

### **Nov. 21: Thanksgiving Break**

No Class

### **Nov. 28: Research Paper presentations**

20-30 minute presentations for each project

### **Dec. 5: Research Paper presentations**

20-30 minute presentation for each project

### **Dec. 10: Final Research Paper due**

Happy Holidays!!

## Other Network Resources

### Academic Organizations and Conferences

- Sunbelt Conference, International Network for Social Network Analysis (INSNA). <http://www.insna.org/index.html>
  - INSNA SOcNET listserv. <http://www.insna.org/pubs/socnet.html>
- Web Science Trust. <http://webscience.org/home.html>
- Communication and Technology Division, Organizational Communication Division. International Communication Association (ICA). <http://www.icaheadq.org>
- Organizational Behavior Division, Organizational Communication and Information Systems Division, Academy of Management (AoM). <http://www.aom.pace.edu>
- Conference on Human-Computer Interaction (CHI), Conference on Computer-Supported Cooperative Work (CSCW), Conference on Supporting Group Work (GROUP), Association for Computing Machinery (ACM). <http://www.acm.org>
- Conference on Social Computing (SocialComp), World Wide Web Conference (WWW), Hawaii Conference on System Sciences (HICSS), Conference on Advances in Social Networking and Mining (ASONAM), IEEE Computer Society. <http://www.computer.org>
- Conference on Network Science (NetSci). <http://netsci2011.net/>
- Conference on Weblogs and Social Media (ICWSM), Conference on Artificial Intelligence (AAAI), Knowledge Discovery and Data Mining (KDD), Association for Advancement of Artificial Intelligence (AAAI). <http://www.aaai.org/>

### Data Sets

- McFarland, D. "Social Network Analysis Labs in R and SoNIA." Stanford University. <http://sna.stanford.edu/rlabs.php>
- Newman, M. "Network data." University of Michigan. <http://www-personal.umich.edu/~mejn/netdata/>
- Leskovec, J. "Large Network Dataset Collection." Stanford University. <http://snap.stanford.edu/data/>
- Batagelj, V. & Mrvar, A. "Pajek datasets." University of Ljubljana. <http://vlado.fmf.uni-lj.si/pub/networks/data/>

- Börner, K., *et al.* “InfoVis Cyberinfrastructure Databases.” Indiana University. <http://iv.slis.indiana.edu/db/index.html>
- Barabasi, A.-L. & Toroczkai, Z. CCNR Lab at the University of Notre Dame <http://www.nd.edu/~networks/resources.htm>

### **People and Research Groups**

- Science of Networks in Communities (SONIC). Noshir Contractor. <http://sonic.northwestern.edu>
- Northwestern Institute on Complex Systems. Daniel Diermeier, Brian Uzzi, Kevin Lynch, William Kath, *et al.* <http://www.northwestern.edu/nico/>
- Amaral Lab. Luis Amaral. <http://amaral.northwestern.edu>
- Center for Connected Learning. Uri Wilensky. <http://www.ccl.sesp.northwestern.edu>
- Research on Complex Systems. Dirk Brockmann. <http://rocs.northwestern.edu>
- Annenberg Networks Network. Peter Monge, University of Southern California. <http://ann.uscannenberg.org/>
- Program for Network Governance. David Lazer, Harvard University. <http://www.hks.harvard.edu/netgov/html/index.htm>
- NETLAB. Barry Wellman, University of Toronto. <http://www.chass.utoronto.ca/~wellman/>
- CASOS. Kathleen Carley, Carnegie Mellon University. <http://www.casos.cs.cmu.edu/>
- MELNET. Gary Robbins, University of Melbourne. <http://www.sna.unimelb.edu.au/>
- LINKS Center. Steve Borgatti, University of Kentucky. <http://linkscenter.org/>
- Santa Fe Institute. <http://www.santafe.edu/>
- Center for the Study of Complex Systems, University of Michigan. <http://www.cscs.umich.edu/>

### **Online Network Courses**

- Social Network Analysis – Lada Adamic (Fall 2012) – Recommended. <https://www.coursera.org/course/sna>
- Networked Life - Michael Kearns (Fall 2012) - Unknown <https://www.coursera.org/course/networks>