

PROGRAM: GNAM

COURSE: Organizational Networks: Maps, Models, and Analysis (ONMMA)

PROFESSOR: Professor Dr. Phokion “Ion” Georgiou

Course Syllabus

GENERAL OVERVIEW

One of the major reasons why organizations – such as institutions, industries, markets, blocs, or simply groups of people – emerge as complex systems is because, behind the perceived complexity, there is a network that defines the interactions between the constituent entities. Uncovering the network, mapping it, tackling its complexity through models, and analyzing the results, yields greater understanding of the dynamics that render organizations complex, and opens means for improving their configuration. Since the dawn of the 21st Century, network science has emerged as one of the most productive analytical concepts that complements statistical and qualitative approaches.¹ Its effectiveness stems from having reconceptualized the focus of analysis: from entities, to the relations that bind them. The relation has become the variable of interest, and network science has developed a host of methods through which relations can be mapped, modeled, quantified, and analyzed. For these reasons, organizational network analysis has been adopted as one of the management toolkits by international consulting firms such as McKinsey, Deloitte, AT&Kearney, RobCross Consulting, and Maven7.²

Network science is the fruit of at least four forces that arose in the 20th Century: advances in graph theory,³ social network research,⁴ communications networks (including the development of the Internet)⁵, and the holistic approach of ecology⁶. Currently, it is broadly divided into two schools. On the one hand, natural scientists apply network concepts and techniques to the fields of physics, chemistry, biology and so forth⁷. On the other hand, organizational theorists are interested in the applications of network science to human contexts. No matter the breadth and depth of interest in such contexts, be it global, regional, industrial, or corporate, organizational networks are formed by, and composed of, people. As such, organizational network approaches take their lead from the field of social network analysis. This is evidenced in organizational network studies of industries⁸, markets⁹, economics¹⁰, politics¹¹, governance¹², geopolitics¹³, human resource management¹⁴, social capital¹⁵, competition¹⁶, the diffusion of innovations¹⁷, and even start-ups¹⁸. All such applications are founded on scholarship that tackles social networks as a general category¹⁹.

LEARNING OBJECTIVES

The Course draws from the methodological approaches in social network analysis applicable to organizational issues, in order to furnish students with the latest tools for doing organizational network research. Familiarization, even fluency, with specialized network software is necessary and, in this respect, the Course introduces organizational network models and analysis using the award-winning software *Pajek*. Overall, the Course provides a foundational understanding of network dynamics; advanced abilities in modeling and analyzing network situations; a systemic perspective of the field; and, enhances decision-making skills for situations characterized by complexity and interconnectedness.

COURSE CONTENT OVERVIEW

The Course focuses on structures of human groups, such as communities, institutions, industries, markets, countries, and blocs. These structures are conceptualized as networks of ties. The ties are the main variable of interest, because they transmit behavior, services, information or materials. The patterns of ties in any one network also provide insights into the entities linked by them. Therefore, the course addresses the concept of network, introducing several types of networks and the ways in which they can be modeled and analyzed visually and computationally. Techniques that combine

relational data (such as links) with nonrelational attributes of entities (such as entity-specific economic indices) are discussed. The nonrelational attributes enhance interpretations of network structure and also enable increasingly focused analyses of subnetworks (say, the trade flows between a particular set of countries situated within a wider trade bloc).

Collective norms, shared strategies, industrial cohesion, market attitudes, and similar behavior emerge from relations between organizational entities. A major concern of organizational network analysis is to investigate who is related and who is not, and why. The Course introduces a variety of techniques to detect cohesive subgroups based on the underlying structure of respective networks. These techniques comprise means to various ends, rather than an end in themselves, and are used throughout the Course as complements to advanced analyses. Furthermore, they enable tests of whether structurally delineated groups differ with respect to various nonrelational attributes. The Course tackles the differences between, and the implications of, grouping entities according to structural properties and non-network attributes. It introduces a variety of network and subnetwork measurements of cohesion, as well as analyses that help identify components according to various criteria. Methods are also introduced for analyzing and optimizing the composition of teams, alliances, and coalitions.

Networks are structures that allow for the transport and exchange of information, services, and materials. In this perspective, familiarization with network structure helps explain diffusion of anything, from a product innovation to a disease. Some sections of networks permit rapid diffusion, whilst others act as bottlenecks. In addition, the position of specific entities in networks gives them social capital, competitive advantages, or allows them to assume a variety of brokerage roles. Such positions may put pressure on certain entities, but can also yield power and profit. The Course introduces various indices of centrality and centralization, as well as various interpretations of these important concepts along with their respective computational techniques. The distinction between an ego-centered and a socio-centered approach to centrality analyses is discussed in depth with associated modeling methodology and analytical tools. The quantitative and qualitative value of links between entities is then introduced as a means for understanding and computing various indices of social capital. A structural approach to the analysis of competition is introduced as a significant complement to other approaches toward this issue. Finally, the Course discusses and models diffusion processes that underlie social, organizational, communicative, administrative, and marketing behavior. The modeling of diffusion through networks is introduced, with a focus on investigating structural positions of entities, their relations, and their diffusion and adoption behavior.

METHODOLOGY

The Course follows the pedagogic approach known as *problem-based learning*.²⁰ The Course content focuses on practice which enables the simultaneous emergence of theory and methods. Students are given regular practical assignments covering a range of issues examined in the course, as well as additional challenges that require some independent research. All assignments require the design of maps, models and analyses in the specialized network software *Pajek*. As such, students learn by doing: they acquire knowledge of network concepts by applying network analysis.

There is no shortage of books that can be used as a textbook for this Course, ranging from the most basic²¹ to the most advanced²², by way of the seemingly intermediate²³. Given the complex nature of networks, however, any such study must be complemented by training in the use of specialized analytical software. As with books, there are numerous software packages available²⁴. Choosing between them should account for the extent to which the user can evaluate the procedures and analyses of a software package, thus enabling control and ownership of its results.²⁵ What is required

is a source that offers a combination of sufficient theoretical and methodological knowledge with hands-on training in a transparent software package.

Such a source is available in its third, revised and updated edition: de Nooy et al's *Exploratory Social Network Analysis with Pajek*²⁶. The book covers issues applicable to the widest possible variety of contexts, but especially focuses on human contexts of interest in organizational network analysis. As for *Pajek*, this refers to an award-winning, freely available²⁷ software package. This software is designed specifically as a network calculator that can handle billions of vertices, and their relations, irrespective of context. It is, therefore, useful for both, abstract and empirical analyses. *Pajek*'s transparency stems from requiring active user engagement, affording precise operational oversight with consequent demystification of the black box. Furthermore, *Pajek* has a long history of published algorithms which are open to evaluation.²⁸ All this enables users to maintain control of their use of the software instead of being controlled by it. In addition, the software provides outstanding graphics of networks, with multiple means for manipulating their aesthetic presentation, thus allowing for sophisticated visual appreciation to complement analytical results.

EVALUATION

Evaluation is based on eight assignments and participation.

Each assignment constitutes 10% of the final mark, making for a total of 80%. The assignments are of varied difficulty and are designed to test various aspects of the course content, at times combining various analytical procedures to demonstrate the nature of advanced analyses. All assignments are due by 21:00 hours, São Paulo Time, on the due date.

Participation constitutes 20% of the final mark. The course content and the assignments are designed to elicit active student involvement throughout the course. Students are expected to attend all online sessions and participate actively, including through questions and comments online. Students are expected to maintain a regular regime of studious reading from the textbook, and other assigned material, and to demonstrate such study through their online participation.

SCHEDULE

The course comprises:

- Pre-produced videos
- Online sessions for group discussion with the professor

Figure 1 shows the topics introduced by each video, the groups of videos associated with each online session, and the corresponding textbook chapter.

Section	Video	Topic	Online Discussion		ESNAP Chapter
			Session	Date	
Fundamentals	1	Introduction to network modeling	1	11/09/2019	1
	2	Multiple relation networks			
	3	Basic automated outputs			
	4	Visualization techniques			
	5	Partitioning and categorization for analysis	2	18/09/2019	2
	6	Local, global, and contextual subnetworks			
	7	Modeling continuous properties			
Cohesion	8	Introduction to basic network components	3	25/09/2019	3
	9	Cohesive subgroups: Cores			
	10	Cohesive subgroups: Cliques			
	11	Modeling alliances and teams (1)	4	02/10/2019	4
	12	Modeling alliances and teams (2)			
Brokerage	13	Measuring importance (1)	5	23/10/2019	6
	14	Measuring importance (2)			
	15	Brokerage (1: bridges and bicomponents)	6	30/10/2019	7
	16	Brokerage (2: ego-networks)			
	17	Brokerage (3: social capital)	7	06/11/2019	
	18	Affiliation and Brokerage roles			
Diffusion	19	Introduction to diffusion modeling	8	13/11/2019	8
	20	Diffusion as contagion modeling			
	21	Diffusion: Exposure and adoption thresholds	9	27/11/2019	
	22	Diffusion: Critical mass and threshold lags			
Prestige	24	Popularity	10	04/12/2019	9
	25	Domains			
	26	Proximity prestige			

Figure 1: Course Schedule

The duration of each video is between 20 and 30 minutes.

The duration of each online session is 1 hour and 30 minutes. Sessions are scheduled to begin at 21:00 hours, São Paulo time. All class sessions are recorded and made available for subsequent viewing.

Prior to attending an online session, students should have studied the associated videos and textbook chapter, as well as practised the examples in the textbook chapter.

READING LIST

COURSE TEXTBOOK

de Nooy W, Mrvar A, Batagelj V (2018) *Exploratory Social Network Analysis with Pajek*. Revised and Expanded Edition for Updated Software. 3rd Edition. Cambridge University Press: Cambridge

Throughout the course, the book is referred by its acronym: *ESNAP*.

Students must acquire the course textbook since it is central to the content and approach of this course.

Students might also wish to consult the following, complementary texts:

- Borgatti SP, Everett MG, Johnson JC (2013) *Analyzing Social Networks*. Sage: London
- Freeman LC (2004) *The Development of Social Network Analysis: A Study in the Sociology of Science*. Empirical Press: Vancouver
- Kadushin C.(2011) *Understanding Social Networks: Theories, Concepts, and Findings*. Oxford University Press: Oxford
- McCulloh I, Armstrong H, Johnson A (2013) *Social Network Analysis with Applications*. Wiley: Chichester
- Scott JP, Carrington PJ (2011) *The SAGE Handbook of Social Network Analysis*. Sage: London
- Wasserman S, Faust K (1994) *Social Network Analysis: Methods and Applications*. Cambridge University Press: Cambridge.

An extended list of relevant texts, including texts specializing in particular applications (such as economics, politics, markets, etc.), will be made available at the beginning of the Course.

PROFESSOR RESUMÉ AND CONTACT

Dr Ion Georgiou is a full professor at the Fundação Getulio Vargas (Escola de Administração de Empresas de São Paulo), specializing in network science, graph theory, problem structuring methods, computer modeling, social science methodology, and historiographical methods. Proficient in five languages, he has lived and worked on four continents. He is the author of *Thinking Through Systems Thinking*, the book that sets out a complete epistemology for systemic approaches to problematic situations, along with their consequent ethical implications. He regularly publishes in top international scientific journals. Relevant to this course is one of his latest publications which uses network science to solve one of the outstanding practical problems in decision-making, first posed in the 1960s by Frank Harary, one of the greatest mathematicians of the 20th Century.²⁹ Another paper that draws on network science is his mapping of the politics-administration dichotomy, a perennial issue at the heart of public administration.³⁰ He is currently working on the application of network science to the composition of teams, alliances, and coalitions. Dr. Georgiou is a chess player and coach, specializing in strategies for black. He is also a specialist on the decision-making origins of the First World War, and on the history of Europe following the Second World War.

Academic Background

PhD Lancaster University, UK (Systems Science)

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- On how it complements statistical and other mathematical approaches, see: Kolaczyk ED (2009) *Statistical Analysis of Network Data: Methods and Models*. Springer: New York; Kolaczyk ED, Csárdi G (2014) *Statistical Analysis of Network Data with R*. Springer: NY; Pattison P (1993) *Algebraic Models for Social Networks*. Cambridge University Press: Cambridge.
- On how it complements qualitative research, see: Dominguez S, Hollstein B (2014) *Mixed Methods Social Networks Research: Design and Applications*. Cambridge University Press: Cambridge
- ² See, for example:
- McKinsey: <https://www.mckinsey.com/business-functions/organization/our-insights/the-role-of-networks-in-organizational-change>
- Deloitte: <https://www2.deloitte.com/us/en/pages/human-capital/articles/organizational-network-analysis.html>
- AT Kearney: <https://www.atkearney.com/leadership-change-organization/network-navigation>
- RobCross Consulting: <https://www.robross.org/research/what-is-ona/>
- Maven7: <http://maven7.com/>
- ³ Harary F, Norman RZ, Cartwright D (1965) *Structural Models: An Introduction to the Theory of Directed Graphs*. Wiley: New York; Harary F (1969) *Graph Theory*. Addison-Wesley: Reading.
- ⁴ Moreno JL (1934) *Who Shall Survive? A New Approach to the Problem of Human Interrelations*. Nervous and Mental Disease Publishing Company: Washington DC
- ⁵ Hafner K, Lyon M (1996) *Where Wizards Stay Up Late: The Origins Of The Internet*. Simon & Schuster: New York
- ⁶ Worster D (1994) *Nature's Economy: A History of Ecological Ideas*. Cambridge University Press: Cambridge
- ⁷ See, for example: Newman MEJ, Barabási AL (2006) *The Structure and Dynamics of Networks*. Princeton University Press: Princeton
- ⁸ Herrigel G (2000) *Industrial Constructions: The Sources of German Industrial Power*. Cambridge University Press: Cambridge; Mizuchi MS (1992) *The Structure of Corporate Political Action: Interfirm Relations and Their Consequences*. Harvard University Press: Cambridge; Mizuchi MS, Schwartz M (1987) *Intercorporate Relations: The Structural Analysis of Business*. Cambridge University Press: Cambridge; Valente, TW (2010) *Social Networks and Health: Models, Methods, and Applications*. Oxford University Press: Oxford; Mizuchi MS (1982) *The American Corporate Network 1904-1974*. Sage: New York; Heemskerk EM (2007) *Decline of the Corporate Community: Network Dynamics of the Dutch Business Elite*. Amsterdam University Press: Amsterdam; Freeland RF (2005) *The Struggle for Control of the Modern Corporation: Organizational Change at General Motors, 1924-1970*. Cambridge University Press: Cambridge; Carolan BV (2013) *Social Network Analysis and Education: Theory, Methods & Applications*. Sage: London
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- ¹¹ Knoke D (1990) *Political Networks: The Structural Perspective*. Cambridge University Press: Cambridge
- ¹² Kogut B (2012) *The Small Worlds of Corporate Governance*. MIT Press: Cambridge
- ¹³ Maoz Z (2010) *Networks of Nations: The Evolution, Structure, and Impact of International Networks, 1816-2001*. Cambridge University Press: Cambridge
- ¹⁴ Kilduff M, Krackhardt D (2008) *Interpersonal Networks in Organizations: Cognition, Personality, Dynamics, and Culture*. Cambridge University Press: Cambridge; Friedkin NE, Johnsen EC (2014) *Social Influence Network Theory: A Sociological Examination of Small Group Dynamics*. Cambridge University Press: Cambridge; Perry BL, Pescosolido BA, Borgatti SP (2018) *Egocentric Network Analysis: Foundations, Methods, and Models*. Cambridge University Press: Cambridge; Crossley N, Bellotti E, Edwards G, Everett MG, Koskinen J, Tranmer M (2015) *Social Network Analysis for Ego-Nets*. SAGE: London
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- ¹⁶ Burt RS (1992) *Structural Holes: The Social Structure of Competition*. Harvard University Press: Cambridge; Burt RS (2010) *Neighbor Networks: Competitive Advantage Local and Personal*. Oxford University Press: Oxford
- ¹⁷ Moon FC (2014) *Social Networks in the History of Innovation and Invention*. Springer: New York; Rogers EM (1995) *Diffusion of Innovations*. Fourth edition. Free Press: New York

- ¹⁸ Tsvetov M, Kouznetsov A (2011) *Social Network Analysis for Startups: Finding connections on the social web*. O'Reilly Media: Sebastopol CA
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