
Encyclopedia of Social Network Analysis and Mining

Reda Alhajj • Jon Rokne
Editors

Encyclopedia of Social Network Analysis and Mining

With 583 Figures and 163 Tables

 Springer Reference

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*To the memory of my parents and to my wife Dima Halabi,
my daughters Aya, Loubaba, and Lama, my sons Suleiman and
Mohammed Taha.*

Reda Alhajj

To Angela, Knut, and Olav for support with this major venture.

Jon Rokne

Preface

The Encyclopedia of Social Network Analysis and Mining (ESNAM) is the first online and print reference work that encompasses a comprehensive collection of articles in the areas of social networks and the mining of social networks.

While social networks is an area of sociology, and mining (i.e., data mining) an area of informatics, the application of mining to online social networks is considered to be a new and important interdisciplinary area of research. ESNAM surveys this new area while also including basic supporting information from both social networks (including the fundamentals of network analysis) and mining.

This new area is essentially an outcome of the widespread introduction of electronic communication. One can hardly imagine Facebook, Twitter, and online pornography existing without the convenience of a widespread Internet. The ability to connect humans over great distances has therefore transformed the notion of social networks from the previously studied relatively small and geographically limited social networks to social networks spanning the globe (and possibly further into space in the future). Together with this ability to seamlessly communicate over arbitrary distances, an ability to collect data about this communication has been enabled. Data on who communicates with whom can be gathered and refined into a social network setting. Once the social connections have been established, they can be analyzed and potentially interesting observations can be extracted.

Social networks are ubiquitous. They can be found in many areas of science and social science. They can be classified in various ways. Explicit social networks model directly known relationships between actors. This is in contrast to implicit social networks where the links between actors can only be inferred by deeper analysis of the available data. Facebook, Twitter, and MySpace are good examples where explicit social networks can be found. Implicit social networks can be found by analyzing Amazon and Netflix logs of activities, for example, for common interests such as political viewpoints or hobbies.

For another classification, stationary items such as pieces of code, stock items, or routers in a network can be viewed as network actors and be grouped together into social communities. Similarly, dynamic actors, such as animals, humans, insects, genes, proteins, etc., can form social communities.

Understanding social communities of dynamic and moving objects like stars or humans, which may be bound by various physical or psychosocial

forces, is fairly intuitive, and their analysis can provide interesting knowledge that is most often easy to understand. Social communities of abstract items tend to be less intuitive, but the analysis of these communities can also result in interesting discoveries such as finding groups of tables in databases that are related and mostly accessed together. These discoveries and insights can lead to better plans or to improved algorithms for prefetching data.

Graphical representations are used to depict the interactions between individuals in a social network and are essential for understanding how information items, innovations, and disease occurrences are connected. Edges in the graph may represent social interactions, organizational structures, physical proximity, or even more abstract interactions such as hyperlinks or similarity. Graph theoretical principles have generally influenced the overall terminology used in social networks and many of the techniques used to analyze the networks as well.

The fundamental issues in social network research were broadly defined in the 1930s within the field of sociology. The early research focused on human social communities and interactions. Rapid progress was made in the 1970s when researchers broadened the study of social networks from a sociological perspective of a study of communities of humans to other animals and to more general communities. For the symbiosis with biology, the term “sociobiology” was introduced in E. O. Wilson’s “Sociobiology: The New Synthesis.”

More recently, the interest in studying human social networks has exploded with the appearance of global web-based communities. People from all over the world are directly or indirectly connected by popular social networks such as Facebook and Twitter rather than by physical proximity as they were in the past. These networks have turned into powerful media for exchanging views and influencing others. The sizes of these networks are growing fast, and traditional techniques for network analysis must yield automated methods for analyzing and handling them.

The study of social communities is extremely multidisciplinary, requiring expertise from computer science, sociology, behavioral science, mathematics, statistics, etc. Data mining techniques and analyses have been applied to gain valuable discoveries with pervasive social and economic impacts in many areas of applied social network research. From the social perspective, application areas include antiterrorism strategies, crime data analysis, disease biomarkers, common hobbies, family relationships, social functions, occupations, and friendship. From the economic perspective, the analyses may lead to certain target customer groups, the development of drugs, etc.

The Encyclopedia of Social Network Analysis and Mining is the first major reference work to integrate all the fundamental concepts and research directions within the areas of social networks and the application of data mining to social networks in a single set of comprehensive and authoritative volumes:

- It presents the first comprehensive coverage of all fields, including computer science, statistics, social and cultural anthropology, and informatics in general, that contribute to an understanding of the structure and function of social networks.

- It is designed to appeal to an interdisciplinary audience and level of expertise ranging from undergraduates to professionals.
- It explains the science and technology behind the fast-growing global social network avenues for exchanging views and influencing others.
- It describes social network applications to knowledge mining and discovery ranging from web mining algorithms to health informatics and epidemiology to antiterrorism strategies.
- It addresses privacy, security, ethical, and civil liberty issues for social networks.

Reda Alhajj and Jon Rokne

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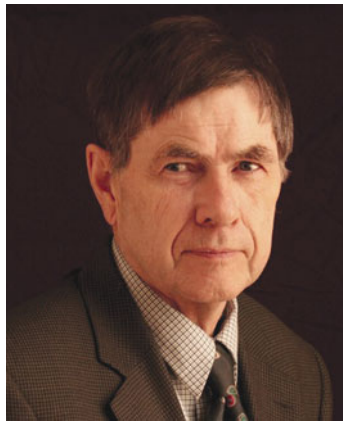
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About the Editors



Reda Alhadj received his B.Sc. degree in Computer Engineering with distinction in 1988 from Middle East Technical University, Turkey. Then, he was offered a full scholarship to join the graduate program in Computer Engineering and Information Sciences at Bilkent University, where he received his M.Sc. and Ph.D. degrees with distinction in 1990 and 1993, respectively. Currently, he is tenured professor in the Department of Computer Science at the University of Calgary. He published over 450 papers in refereed international journals and conferences. He served on the program committee of several international conferences. He is founding editor-in-chief of the Springer premier journal *Social Networks Analysis and Mining*, founding editor-in-chief of the Springer series “Lecture Notes on Social Networks,” founding editor-in-chief of the Springer journal *Network Modeling Analysis in Health Informatics and Bioinformatics*, founding co-editor-in-chief of Springer’s *Encyclopedia on Social Networks Analysis and Mining*, and founding steering chair of the flagship conference IEEE/ACM International Conference on Advances in Social Network Analysis and Mining and of two accompanying symposiums, FOSINT-SI and HI-BI-BI. He is member of the editorial boards of the *Journal of Information Assurance and Security*, *Journal of Data Mining and Bioinformatics*, and *Journal of Data Mining, Modeling and Management*; he has been guest editor of a number of special issues and edited a number of conference proceedings. Dr. Alhadj’s primary work and research interests

are in the areas of computational biology and bioinformatics, data mining, social networks, XML, schema integration, and reengineering. He currently leads a large research group of Ph.D. and M.Sc. candidates. He received the Best Graduate Supervision Award from the University of Calgary. Dr. Alhajj recently received with Dr. Jon Rokne a donation of equipment valued at \$5 million from RBC and Teradata for their research on computational intelligence and bioinformatics research. He recently mentored a number of successful teams, including SANO who ranked first in the Microsoft Imagine Cup competition in Canada and received the KFC Innovation Award in the World Finals held in Russia in July 2013, TRAK who ranked in the top 15 teams in the 2014 Open Data Analysis competition in Canada, and Go2. There who ranked first in the Imagine Camp competition organized by Microsoft Canada in March 2014.



Jon Rokne is a professor in the Department of Computer Science at the University of Calgary. Educated in Norway and Canada he obtained a Ph.D. in mathematics from the University of Calgary. He chaired the Computer Science Department at the University of Calgary from 1989 to 1996. He has published extensively in mathematics, including three jointly authored books. His main applied mathematics interest has been interval analysis, global optimization, and numerical solution of nonlinear equations. In computer science, the focus has been computer graphics, computational geometry, data analysis, social networks, and physically and biologically based computer simulations with publications on leaves, auroras, and ball lightning. He has published one jointly authored computer science book entitled “Light Interaction with Plants.” In 2003, he organized the Pacific Graphics conference where he jointly edited the proceedings and two special issues of computer graphics journals. He has been an active volunteer with IEEE and has had a number of positions within the organization, including vice-president of publications for IEEE Computer Society and vice-president of publications and board member of IEEE. He spearheaded the three new publications: IEEE Transactions on Cloud Computing, IEEE Cloud Computing Magazine, and IEEE Transactions on Big Data. He chaired the 2013 ASONAM Conference and has been an organizer for other ASONAM conferences.

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