



## A SYSTEMATIC REVIEW ON SOCIAL NETWORK ANALYSIS

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**Abstract-** Network concept is in the area of interest of scientists for many years and is increasingly gaining popularity as a study field. Especially in recent years a very large group of researchers varying from mathematicians to sociologists and computer scientists are trying to examine different aspects, features and types of networks. Social network analysis is a large and growing body of research on the measurement and analysis of relational structure. Here, we review the fundamental concepts of network analysis; its properties, challenges as well as benefits are discussed. The paper presents an engraved review of need of social network analysis and also the implications associated with the same. It is discovered that there are lot of parameters which must be considered while analyzing any social network and also this analysis spans from pure mathematical modeling to graphical representations.

**Keywords** - Social Network Analysis, Social Network sites, Visualization, Ego network analysis and Complete network analysis

### I. INTRODUCTION

A social network is a social structure made up of individuals called nodes, which are tied by one or more specific types of interdependency such as friendship, common interest, dislikes, belief. Social network analysis examines the structure of social relationships in a group to uncover the informal connection between people. Social network analysis is based on an assumption of the importance of relationships among interacting units. It indicates the way in which they are connected through different social familiarities ranging from casual acquaintances to close familiar bond (Koçak 2014).

In recent years several attractive and user-friendly facilities have been introduced to online society and we see an extensive and increasing participation of people in various online activities like several kinds of content publishing (blogging, writing reviews etc.) and having different kinds of relationships and interactions. The huge amount of information that is generated in this way by people has never been available before and is highly valuable from different points of views. An outstanding phenomenon that has had a significant influence on this extensive participation and includes a large part of generated information is SNSs (Social Network Sites). (Soryani and Minaei 2011)

### II. LITERATURE REVIEW

(Gama 2012) In the modern paradigm of IOT “Internet of Things” and big data, we deal with augmented volume of information on regular basis. Due to advancement in the data flow, there is a fair chance of data loss and its misuse. To manage this, it is usually required to draw whole information in form of graphs or presentable form which is termed as social network. In this context, to get some calculative idea about social relations from that network is called a Social Network Analysis (SNA). The research on SNA has been continuously performed from last decade or so. It is required to review and present major contributions in SNA to research community. Therefore, this article conducts a Systematic Literature Review (SLR) to select fifty two research studies. As a result, twenty three algorithms, eleven tools and ten frameworks in the domain of SNA have been presented. This facilitates researchers to discovery latest SNA developments within a single study.

(Pupazan n.d.) From the study of author, he analyzed that in recent years, the online community has moved a step further in connecting people. Social Networking was born to enable people to share more, on social and professional level. Due to its potential, significant scientific and technological efforts are made to better understand, control and extend this phenomenon. The public accessibility of web-based social networks stimulated extensive research in this domain. Understanding how networks grow and change, and being able to predict their behavior, contributes to the evolution of other domains such as business, education, social, biology, fraud detection, criminal investigation etc. This paper surveys fundamental concepts of social networking analytics as well as a set of established models for the problem of link prediction. Two case studies are supporting the paper: the first study treats the problem of influential behavior by measurements of centrality and power; the second study compares the accuracy of three classification algorithms for a case of co-authorship link prediction.

(Jamali and Abolhassani n.d.) According to author, a social network is a set of people (or organizations or other social entities) connected by a set of social relationships, such as friendship, co-working or information exchange. Social network analysis focuses on the analysis of patterns of relationships among people, organizations, states and such social entities. Social network analysis provides both a visual

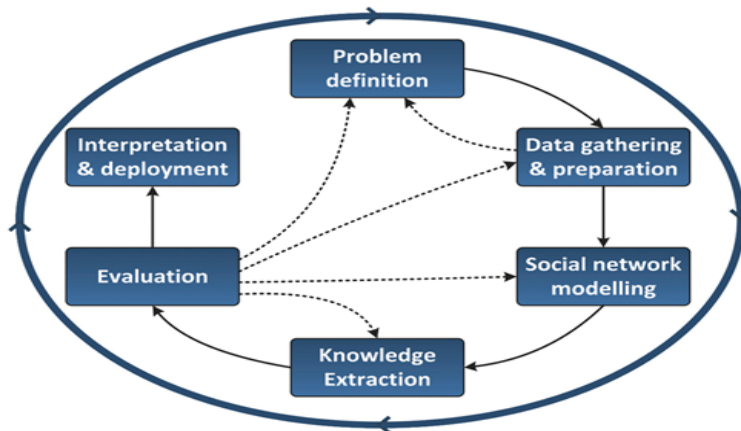


and a mathematical analysis of human relationships. Web can also be considered as a social network. Social networks are formed between Web pages by hyperlinking to other Web pages. In this paper a state of the art survey of the works done on social network analysis ranging from pure mathematical analyses in graphs to analyzing the social networks in Semantic Web is given. The main goal is to provide a road map for researchers working on different aspects of Social Network Analysis.

(Gama 2012) Author explained that Data mining is being increasingly applied to social networks. Two relevant reasons are the growing availability of large volumes of relational data, boosted by the proliferation of social media web sites, and the intuition that an individual’s connections can yield richer information than his/her isolate attributes. This synergistic combination can show to be germane to a variety of applications such as churn prediction, fraud detection and marketing campaigns. This paper attempts to provide a general and succinct overview of the essentials of social network analysis for those interested in taking a first look at this area and oriented to use data mining in social networks.

### III. SOCIAL NETWORK ANALYSIS

Social network analysis is based on an assumption of the importance of relationships among interacting units. Social network analysis (SNA) is the process of investigating social structures through the use of network and graph theories. It characterizes networked structures in terms of nodes (individual actors, people, or things within the network) and the ties, edges, or links (relationships or interactions) that connect them. Social network analysis is a powerful key to ensure useful visualization of a social network.(Kharb 2017) Using SNA, users can flexibly iterate through visualizations of nodes and links, thereby understanding system clearly; aggregate it’s various available networks on the basis of subgroups of interest; explore networks by finding patterns across different networks. A visualization system works for end-users of social networking services to provide an increased awareness and discovery of the online social community. The visualization of networks is important because it is a natural way to communicate connectivity and allows for fast pattern recognition by humans and is useful to grasp the perceptive abilities of humans, but overlapping links and indistinct labels of nodes often ruin this approach. Network analysts have always been able to learn by generating and sharing visual images. Modern technology promises to enhance our ability to learn from images by continuing to provide new tools that allow for more powerful visualizations.(Koçak 2014)



**Figure.1 Procedure for Social Network Analysis**

Social network analysis (SNA) is the methodical analysis of social web. SNA observes the behavior of peoples on various topics and their social relationships in terms of net theory, consisting of nodes (representing individual actors inside the network) and ties (which represent relationships between the people, like relationship, kinship, structure position, sexual relationships, etc.) (Pupazan n.d.). Social network analysis as a research field includes: structural intuition, relational data, visual representation, and mathematical & computational models.

Expectations from the results acquired by social networking analysis:

- Coming across the shape of social networks.
- Finding numerous characteristic values for the web. E.g. Centrality, between-ness, density, etc.
- Locating groups inside the social community.
- Conceptualizing the overall or part of the social web.

Several works are done on varied social networks to analyses and find out varied sorts of relationships and knowledge.

Kinds of Network Analysis: There are 2 basic forms of SNA, i.e.

- Ego network analysis;



- Complete network analysis.

**Table 1: Difference between socio-centric and ego-centric:** (Ganesh 2009)

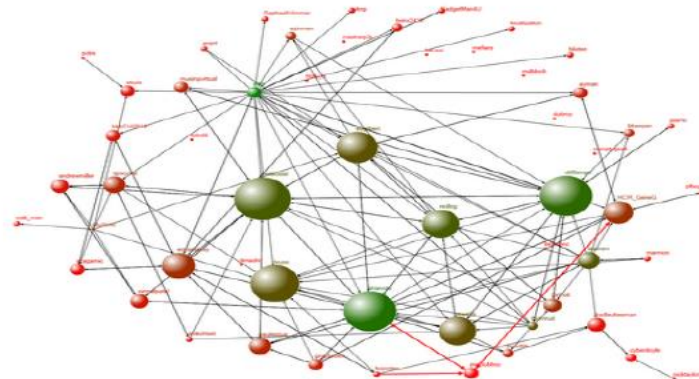
Socio-centric (Whole/ Complete Network)	Ego-Centric (Ego/Personal Network)
Focus on the complete cluster	Focus on individual ego networks
Global structure	Structure
Patterns of interaction used to explain:	Composition
Concentration of power	Shape
Flow of data or resources	Cases are individual ego networks
Status structures	Generalized to other ego networks

*A. Uses of Social Network Analysis*

- Recognizing unknown facts changing into commercially viable, e.g. RFID, ordination sequencing, tissue engineering.
- In computer-supported cooperative learning.
- Numbering of trends, of writers, of corporations commercializing trend.
- Reviewing page necessity Page Rank (Related to algorithmic in-degree computation), authorities/hubs.
- Finding Communities: discovering near-cliques.

*B. Basic Concept in Social Network Analysis*

A *social network* can be defined as a finite set of *actors* and their *relationships*. This is a simple and direct concept, allowing everyone to understand the social network according to the complete data and the connectivity of a considered network. (Kot n.d.)



**Figure 2 Social Network**

An actor is the social entity who participates in a certain network and who is able to act and form connections with other actors. It could be an individual, a corporation or a social body. Examples of actors could be the students in a classroom, the departments in a company, the states of a federation, the web sites of a given business sector, the member nations of the UN etc. When all the actors of a network are of the same type, the network is called monomodal. But there are cases in which there are different actors in a network. In a multi-agent system, the actor is called an agent. (Network 2006)

To study networks of various relationships in an objective way, models need to be created to represent them. There are three notations currently in use in the social network analysis (Srivastava 2014):

- Graph Theory: the most common model for visual representation, it is graph based;
- Socio metrics: proposes matrices representation, also called socio matrices;
- Algebraic: proposes algebraic notations for specific cases, especially for multiple relationships.



IV. SOCIAL NETWORK PROPERTIES

There are some properties of social networks that are very important such as size, density, degree, reachability, distance, diameter, geodesic distance. Here we describe some more complicated properties which may be used in social network analysis(Rousseau 2002). The following properties are taken from:

**Maximum flow:** One notion of how totally connected two actors are, asks how many different actors in the neighborhood of a source lead to pathways to a target. If one need to get a message to other, and there is only one other person to whom one can send this for retransmission, one’s connection is weak - even if the person send it to may have many ways of reaching to other.(Nart et al. n.d.) If, on the other hand, there are four people to whom one can send message, each of whom has one or more ways of retransmitting ones message to other, then ones connection is stronger. This “flow” approach suggests that the strength of ones tie to other is no stronger than the weakest link in the chain of connections, where weakness means a lack of alternatives.(Butts 2008)

**Hubbell and Katz cohesion:** The maximum flow approach focuses on the vulnerability or redundancy of connection between pairs of actors - kind of a “strength of the weakest link” argument. The Hubbell and Katz approaches count the total connections between actors (ties for undirected data, both sending and receiving ties for directed data). Each connection, however, is given a weight, according to its length.(Martino and Spoto 2006) The greater the length is observed, the weaker the connection is.

**Taylor’s Influence:** The Hubbell and Katz approach may make most sense when applied to symmetric data; because they pay no attention to the directions of connections. The Taylor measure, like the others, uses all connections, and applies an attenuation factor. Rather than standardizing on the whole resulting matrix, however, a different approach is adopted. The column marginal for each actor are subtracted from the row marginal, and the result is then normed.(Martino and Spoto 2006)

**Centrality and Power:** All sociologists would agree that power is a fundamental property of social structures. Table given below summarizes some of the main approaches that social network analysis has developed to study power, and the closely related concept of centrality.(Friemel 2017)

Table 2: comparing three aspects of power in sociograms(A. E. Mislove 2009) (degree, closeness, and betweenness)

Power Aspect Name	Definition	Influences
Degree	Number of ties for an actor	Having more oppurtunities and alternatives
Closeness	Length of paths to other actors	Direct bargaining and exchange with other actors
Betweenness	Lying between each other pairs of actors	Brokering contacts among actors to isolate them or prevent connections

A. Challenges

- Size: SNA has been applied in a broad range of research fields. Due to the wide usage of computerized and rapid developments of networked information sharing techniques, many types of large social networks have emerged in a wide range of research fields which play critical role in studying structural properties.(A. Mislove et al. 2007)
- Long processing Time: As network size increases the time for analyzing network grows rapidly, which is usually not linear. Although computer power has been grown fast, handling large network will take a huge amount of time even if we use the fastest single processor available. (Rousseau 2014)However in many applications time is vital. Processing large social networks will require a great amount of computational resources, such as memories in computers. Every social network analysis package runs on a single.
- Graph Dynamism: Almost all networks are dynamic communities in friendship/acquaintance network keep evolving as people join new groups and/or quit old ones. There are always new papers or collaborative work inserted in citation or co-authorship network.(Ganesh 2009) Graph dynamism does not seem troublesome if the size of network is small as analyzing small networks takes small time and changes occurred during this time either have little effect or changed can be analyzed again. However dynamism is vital for large network analysis process.
- Biasing: Large social networks are infeasible to crawl completely. Most of the approaches rely on the statistical properties of sample, smaller in size, as representative of complete network. (Engineering, Some, and Engineering 2013) Many sampling algorithms suffer from biasing i.e. most of the algorithms select nodes with the higher degree first. Biasing affects resemblance of sample to the actual network considerably.



A. *Benefits*

- Identify the individuals, teams, and units who play central roles.
- Discern information breakdowns, bottlenecks, structural holes, as well as isolated individuals, teams, and units.
- Make out opportunities to accelerate knowledge flows across functional and organizational boundaries. (Cao, Lowry, and Lowry 2015)
- Strengthen the efficiency and effectiveness of existing, formal communication channels.
- Raise awareness of and reflection on the importance of informal networks and ways to enhance their organizational performance.
- Leverage peer support.
- Improve innovation and learning.
- Refine strategies.(Gama 2012)

V. CONCLUSION

Social network analysis is a typical example of an idea that can be applied in many fields. With mathematical graph theory as its basis it has become a multidisciplinary approach with applications in sociology, the information sciences, computer sciences, geography etc.

Social Network Analysis has always been popular to give analytical inferences about the society which have diverse areas of successful applications. Social network analysis methods provide some useful tools for addressing many aspects of large social networks. As an area of active interest, the techniques of social network analysis are likely to see considerable development in the years ahead. By making use of these innovations, researchers in psychology and allied sciences can better predict and account for the structural dimensions of social processes.

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