A GENERAL STUDY ON METHODS, MODELS AND TOOLS FOR SOCIAL NETWORK ANALYSIS

K.K.Uma,
Ph.D,Research Scholar,
Department of Computer Science,
Erode Arts and Science College [Autonomous],
Erode, Tamilnadu, India.

Dr.K.Meenakshisundaram,
Associate professor,
Department of Computer Science,
Erode Arts and Science College [Autonomous],
Erode, Tamilnadu, India.

Abstract: Social Network Analysis is a branch of social science which seems for a long time to have resisted the integration of empirical research and not surprising an interdisciplinary endeavor. Nowadays, hundreds of millions of Internet users participate in social networks, form communities, produce and consume media content in revolutionary ways.The concept of social network analysis developed out of propitious meeting of social theory and application with formal mathematical, statistical and computing methodology. SNA provides both a visual and a mathematical analysis of human relationships. The social network perspective encompasses methods, models, and software applications and tools that is based on an assumption of the importance of relationships among interacting units. With the aim of producing effective idea on social network analysis a platform for studying the basic phenomena are discussed. The paper is concerned with the structural properties of the model, patterning methods, facilitating tools, sites and software are studied. We hope the discussed topics here will provide ideas to researchers in various other field as well.

Key Words: Social Network Analysis, Methods, Models and Tools.

I.INTRODUCTION

Social network analysis (SNA) is a tragedy for investigating social structures through the use of network and graph theories. It characterizes networked structure in terms of nodes (individual, common people within the network) and the ties or edges (relationships or interactions) that connect them. Examples of social structures, commonly visualized through social network analysis that include social media networks, friendship and acquaintance networks, disease transmission, and sexual relationships [6].

A social network is a grouping 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 patterns of relationships among people, organizations, states and such social entities [8]. Social network analysis provides both a visual and a mathematical analysis of human relationships. It describes the mapping and the measuring of relationships and flowsbetween people, groups, organizations and other are connected information/knowledge entities. The nodes in the network are the people and groups while the links shows the relationships or flows between the nodes. Actors and their actions are viewed as interdependent rather than independent and autonomous units. The relational ties (linkages) between the actors are channels for transfer or "flow" of resources. Collective social unitsin a network called as Actors/Node [2]. The actors are called the nodes and the ties are usually called as arcs or edges, depending on whether the graph is directed or not. SNA is often diagrammed with points (nodes) and lines (ties) to present the intricacies related to the social networking. Professional researchers to perform the analysis using the software and unique theories and methodologies.

Network models are focusing on individuals view the network structural environment as providing opportunities for constraints on individual action. The network models conceptualize structure as lasting patterns of relations among the actors. Social network analysis is neither a theory nor methodology. It is a perspective nor paradigm. It takes as its starting point the premise that social life is created primarily and most importantly by relations and the patterns they form.

II. SOCIAL NETWORK ANALYSIS-METHODS

Network analysis (or social network analysis) is a set of mathematical methods used in social psychology, sociology, ethology, and anthropology. Network analysis assumes that the way the members of a group can communicate to each other affect some important features of that group. Network analysis makes use of mathematical tools and concepts that belong to graph theory. Network analysis deals with the set of mathematical methods which is used in social psychology, sociology, ethology, and anthropology. Network analysis assumes that the way the members of a group can communicate to each other affect some important features of that particular group. Social network analysis makes use of mathematical tools and concepts which belong to graph theory.

Social network analysis is focused on uncovering the patterning of people's interaction and intuitive notion that these patterns are more important features of the lives of the individual .Social network analysts focuses that how an individual lives depends in large part on how that individual is tied into the larger web of social connections [3]. People hope,that the success or failure of societies and organizations often depends on the pattern of their internal structure.

Numerous methods of visualization for the data produced by the Social Network Analysis have been presented.

Social network analysis is evident that theoretical studies of processes and collective behavior taking place on the social networks and its extensively used in a large range of applications and disciplines that include applications like data aggregation and mining, network propagation modeling ,sampling, user attribute and behavior analysis, community-maintained resource support, location-based interaction analysis, social sharing and filtering, systems development, and link prediction and entity resolution [5].

A. Using Formal Methods: The basic aim for using mathematical and graphical techniques in social network analysis is to represent the descriptions of Networks compactly and systematically. A related reason for using particularly mathematical formal methods for representing the social networks is that mathematical representations allows us to apply computers to the analysis of network data.

B. Using Graphs Methods: A graph theory is the study of graphs, which are mathematical representation of a network used to model pairwise relations between objects. It is also referred to as mathematical tool to model relationships between nodes (the actors) and edges (the relationships) in social network that involves density degree, in degree and out degree, Path and cycles, Distance, diameter Components Clustering coefficient [1]. A graph consists of a set of directed and undirected "vertices" or "nodes", with certain pairs of these nodes connected by "edges" or "arcs" .The extremely brief introduction of graph theory may be undirected, means that there is no distinction between the two vertices associated with each edge, and directed means that its arcs may be directed from one vertex to another.

C. Using Matrices Method : The simplest and most common matrix is binary .The most common form of matrix in social network analysis is composed of as many rows and columns as there are actors in the data set, and in the matrix the elements represent the ties between the actors. .Graph can be represented as matrix in many different ways for different purpose.

- Adjacency matrix
- Edge list
- Adjacency list
- Laplace matrix

II. SOCIAL NETWORK ANALYSIS-MODELS

This section is reviewed with the models for estimating and testing parameters, assessing goodness for fit, etc. During the last 10 years, tremendous developments have taken place in network modeling for network analysis. Models are of different types depending upon the network type, for instance Single network include models such as Conditionally Uniform Models, Latent Space Models Exponential Random Graph Models. Network dynamics work with Continuous-time models, Actor-oriented models, Dynamic Exponential Random Graph Models, Hidden Markov Models and so on [7]. For completeness, in addition to the models described here, other classes of models include markov random fields, stochastic block models, the mixed membership models and stochastic block mixed membership models, cluster wise

p*Models each of which model the relational data in various ways, and seek to include the properties that other models do not. Most of the models reviewed here have been applied fruitfully in diverse areas of network science.

A. Erdos-Renyi or Bernoulli
In graph theory, the Erdős–Rényi model is closely related model for generating random graphs. They are named after Paul Erdős and Alfréd Rényi, 1959. The Erdos-Renyi model is also known as a Bernoulli network. In the mathematics literature, The Erdos-Renyi model graph is treated as a mathematical object with interesting properties that allow for theorems to be proved. In the model introduced by Erdős and Rényi, all graphs on a fixed vertex set with a fixed number of edges are equally likely. The models can be used in the probabilistic method to prove the existence of graphs satisfying the various properties, or to provide a rigorous definition of what it means for a property to hold for almost all graphs [11].For the fixed set of nodes, there are pairs of nodes, or dyads which can either be connected by an edge or not. Under the assumption of symmetry, there are possible observed networks. They are not all equally likely. For example, the simplest underlying the distribution is the Erdos Renyi model in which it assumes that for every pair of nodes, with the probability of an edge exists between the two nodes. Thus under this model, observing a network with all nodes attached to all the other nodes has probability , while observing network with all nodes disconnected has the probability. And of course there are many other possible networks between these two extremes.

B. Exponential Random Graph Model
It is desirable to have the models that they capture these real-world properties of networks. Within sociology, a class of the models that has become widely used is the exponential random graph models (ERGM's), (for example, see Robins et al and Wasserman and Pattison) that also known as p* models. These models are distributed over the space of all the possible networks. Here is the random variable, matrix, which represents a network. The general form of these models is where the parameters are and the sufficient statistics are and is a normalizing constant [7]. For example, is an ERGM, where and could be the graph statistics: the number of triangles, number of edges and number of "2-stars". Additional possible is the graph statistics that have been introduced include: k-stars, degree, alternating k-stars, alternating triangles. A positive value would indicate the tendency towards a larger number of triangles.

The reasons for introducing the graph statistics, aside, of course, to make ERGMs as general as possible, and has mentioned, the graph statistics correspond to aspects of real world networks such as reciprocity, clustering, mutuality and the transitivity (if knows and , then and are more likely to know each other). A Bernoulli network is a special case of an ERGM.

C. Latent Space Models

Motivated by problems of model degeneracy and instability in the exponential random graph models, and describing these

problems as "defects in the models themselves" which cannot be addressed by the alternative estimation procedures, Hoff, Raferty and Hancock introduced latent space models. It observed data is an social network with the entries denoting relationships between nodes and corresponding covariate information [10]. Unobserved are unknown the latent positions, , in social space, for all the nodes , such that conditional upon the unobserved positions, the edges in the network are independent and treated as parameters and to estimate in model where the terms in the product can be modeled using the logistic regression. Maximum are Likelihood Estimates (MLE)'s and are found using MCMC methods.

D. Watts-Strogatz Networks

Duncan Watts and Strogatz proposed the "small-world networks", which lie on the spectrum between the completely random (Erdos-Renyi) and "completely regular" graphs and it capture the real world phenomenon of the six degrees of separation. The model also became as known as the (Watts) beta model after Watts it is used to formulate it in his popular science book Six Degrees [4]. The algorithm used to construct the small-world network is as follows: randomly generate a ring lattice with vertices and edges per vertex, then for each edge, rewire it with the probability where it represents the regularity end of the spectrum and it represents extreme disorder. Sensitivity analysis on parameters and reveal that produces a sufficiently connected graph, sufficient in it resembles observable real-world graphs. Further, graph statistics and the characteristic the path length, and clustering coefficient, respectively, it measures typical separation between two nodes and the cliquishness of "typical neighborhood".

For certain values and are sufficiently greater than and, the graph statistics for a completely random graph, and so as to be defined as small-world networks. The Watts and Strogatz model also implies a fixed number of nodes and thus cannot be used to the model network growth. And the model is that which produces networks that are homogeneous in the degree, while observable real-world networks that tend to be scale-free and in homogeneous in degree. A number of models for the social networks can be subsumed under this category. The field reviewed here in a state of vigorous development, and the models treated are being extended in various ways.

A lot of the interesting problems lie not in modeling the networks themselves, but rather in finding algorithms or models that explore the following classes of problems, some of them are listed here.

- Finding "influential" nodes.
- Epidemics or cascades on networks, diffusion of information.
- Community Detection.
- Network dynamics over time.
- Sampling methods on networks, including Respondent Driven Sampling.
- Experiments and causal modeling on networks.
- Finding clusters.
- Dealing with very large scale networks, algorithms and approximations.

- Making inferences about unobserved attributes or relationships.

III.SOCIAL NETWORK ANALYSIS SITES,SOFTWARE AND TOOLS

Social networking sites are web sites that allow users to register and create their own profile page containing information about themselves (real or virtual), to establish the public 'Friend' connections with other members and to communicate with other members [9]. Communication typically takes the form of private emails, public comments written on each other's profile pages, blog or pictures, or instant messaging. SNS like Facebook and Myspace are among the ten most popular web sites in the world SNS are very popular in many countries, including Orkut (Brazil), Cyworld (Korea), and Mixi (Japan).

One interesting aspect of SNAis that they support relatively to public conversations between friends and acquaintances [13]. Moreover, demographic information about the sender and recipient are also often available in their profile pages. A standard issue adhering potentially arises with this kind of data because its owners have not explicitly given permission for its use in research.

A. Sites for Social Network Analysis

- **Alter Wind Log Analyzer Professional** - Website statistics package for professional webmasters, with standard log analyzer features and unique features for pSEO (Search Engine Optimization) and website promotion. **Click Tracks** - Displays visitor patterns directly on the pages of your website.
- **Conversion Track from Antssoft** - Web log analysis and reports on visitor conversion ratios.
- **Core Metrics**- A web analytics solution capturing every click by every visitor over time and storing them in Coremetrics secure Lifetime Individual Visitor Experience (LIVE) Profiles database.
- **Download Analyzer -** Can track visitors, hits, downloads, referring sites and search phrases, and provide traffic analysis data for web promotion and search engine optimization.
- **INSNA** - Is the professional association for researchers interested in social network analysis.
- **SNAP** - Stanford social network analysis site, with software, datasets, papers, and more.
- **Web Identity Search Tool (WIST)**- For investigating data on Facebook, including finding the degrees of separation between two users.
- **WebLog Expert 2.0 -** For Windows, an easy-to-use and feature packed web log analyzer.
- **WebTrends** - Suite for Data Mining of web traffic information.
- **123LogAnalyzer** - Simple to use, high-speed processing, low disk space requirements, filtering, and built-in IP mapping.

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B.SNA TOOLS

We review the major tools and packages for the Social Network Analysis and visualization, which has wide applications including biology, finance, sociology, network theory, and many other domains[12]. Here is a list of top Social Network Analysis and Visualization Tools which have been found:

- **Centrifuge** - Offers analysts and investigators an integrated suite of capabilities that can help them rapidly understand and glean insight from new data sources.
- **GraphInsight** - Explore your graphs through high-quality 2D and 3D visualizations.
- **Hypersoft OmniContext** - Helps evaluate communication and collaboration, understand relationships and identify communities and members across geographies, divisions, and internal and external organizations.
- **Idiro** - SNA Plus, social network analysis platform, supports Hadoop and Big Data.
- **InFlow** - Software for social network analysis & organizational network Analysis.
- **KXEN Social Network Analysis (KSN)**- Social network analysis solution for a deeper understanding of customer interactions, the customer connections and communities.
- **NetMiner**- For Exploratory Analysis and Visualization of Network Data.
- **Networked Insights** - Works at the intersection of social networking, collective intelligence, and search, Networked Insights discovers customers' needs as they happen.
- **NetworkX** - A Python language software package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.
- **Sentinel Visualizer**- with the capabilities of advanced Social Network Analysis, providing the ability to see and analyze complex relationships that exist within data.
- **Sonamine** - Performs scalable customized scoring of massive social networks and graphs.
- **SVAT** - Smart Visual Analytics Tool, for data visualization, fraud investigation, and more.
- **Svivot** - Offers fraud-detection solution based on analysis of networks of people and organizations.
- **UCINET**- A package for social network analysis.

C. Social Network Analysis-software

Social network analysis software which facilitates quantitative or qualitative analysis of social networks, by describing features of a network either through numerical or visual representation [13]. SNA software generates these features from raw network data formatted in an edge list, adjacency list, or adjacency matrix (also called sociomatrix), often combined with (individual/node-level) attribute data. Though the majority of network analysis software uses a plain text ASCII data format, some software packages contain the capability to utilize relational databases to import and/or store network features.

- **Graphviz** - Open source graph visualization software.
- **JUNG** - The Java Universal Network/Graph Framework, a software library for the modeling, analysis, and visualization of network data.
- **Libsna -** Python open-source library for Social Network Analysis.
- **Maltego Community Edition** - An open source intelligence and forensics application; allows you to identify key relationships and networks. Commercial edition available.
- **Network Workbench** - A large-scale network analysis, modeling and visualization toolkit for biomedical, social science and physics Research.
- **Networkx** - Python package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.
- **Pajek** - Program for Large Network Analysis.
- **R** - Includes several packages relevant for social network analysis.
- **Social Networks Visualiser (SocNetV) -** A flexible and user-friendly tool for the analysis and visualization of Social Networks.
- **Subdue**- Graph-based knowledge discovery system that finds structural, relational patterns in data representing entities and relationships.
- **Statnet** - A suite of R packages for social network analysis, simulation and visualization.
- **Tulip**- An information visualization framework dedicated to the analysis and visualization of relational data.

IV.CONCLUSION

The purpose of the social network analysis is to identify the important actors, crucial links, roles, dense groups, and so on. The article is concerned with a focus on models, methods, tools, software and sites relevant for social networks and analysis. Network analysis has been booming and developing for the several decades. The goal of this publication was to provide an initial base line to build the discussion forum on the social networks as a new multidisciplinary research field by considering four main aspects: state of the art overview, network differences, SNA overview and their related models.

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