Social Network Analysis Tools for Career Advancement

Timothy Arndt
Department of Electrical Engineering and Computer Science
Cleveland State University
Cleveland, OH 44115, U.S.A.
t.arndt@csuohio.edu

***Abstract*—Social networks, which have been studied by sociologists for many decades, have risen greatly in visibility due to the widespread growth of online social networks like Facebook, which facilitate the analysis of social network structures by special purpose software tools. Sociologists have long recognized that special advantage can accrue to individuals who occupy certain strategic locations in their social networks, or whose local neighborhood in their social network exhibits certain characteristics. In this paper describing our initial research directions in this area, we propose to develop social network analysis tools which will allow individuals to analyze their social networks with the express purpose of cultivating or pruning social ties which will enhance their career advancement prospects within an organization. This paper presents our work in progress in this area.**

Keywords-social networks; software tools; social simulation; legal aspects.

I. INTRODUCTION

Social networks have been the object of study by sociologists for many decades. In recent years, with the availability of software for analysis of the social network structures, as well as with the growth of online social networks like Facebook, LinkedIn, and Google+, the computer science community has become interested in studying, analyzing and categorizing social networks of various types, both online information networks as well as the more traditional informal social networks which sociologists have studied [1].

Social networks can be modelled by a graph structure where the nodes represent individuals and the links (ties, in social network terminology) represent some relationship between individuals. An illustration of part of an example social network is shown in figure 1. The social network has eight individuals (A through H) and 13 ties among those individuals.

Depending on the amount or degree of interactions between two individuals, we may characterize a tie between them as either a strong tie (much interaction) or a weak tie (little interaction) [1]. One famous result in the field of social network analysis is that reported by Granovetter [2], who found, surprisingly, that most persons reported that they found a new job not through persons with whom they had strong ties, but rather among those with whom they had weak ties. The reason for such a result is that those colleagues with which we have strong ties are likely to have the same knowledge which we have, so new opportunities, such as job openings are likely to come from those individuals with which we have only weak ties.

For example, in figure 1, maybe all of the ties are strong ties except for that between C and E, which is a weak tie. Individuals A through D might be members of one organization while E through H might be members of a different organization. C might learn of an opening in E's department through his (weak) tie with E. Furthermore, the theory of triadic closure suggests that if E had a strong tie to C, then ties would develop between E and A, B, and C (either weak or strong) as well.

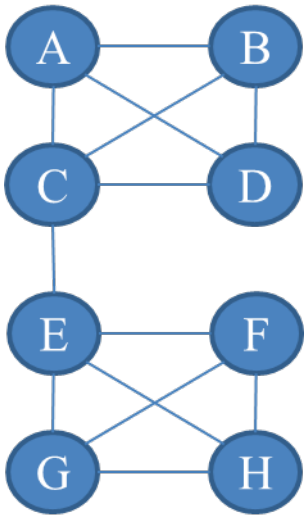

Figure 1 – Part of a social network

The theory of social networks suggest that social capital exists when people have an advantage over their rivals because of their position in some social network. Normally, social structures have a dense structure of strong ties among the participants in the network. This dense structure of strong ties tends to engender trust among the participants, and thus is usually something to be cultivated. On the other hand, in large scale networks, not all of the individuals are members of the same cluster. There may thus exist multiple clusters. When two clusters contain non-redundant information . there

 ISBN: 978-1-61208-443-5

is said to be a structural hole between them [6]. A node which is the only (local) connection between two such clusters as said to be a (local) bridge. The person who is the bridge between two clusters gains much social capital, since he can act as a broker for the flow of information between two clusters.

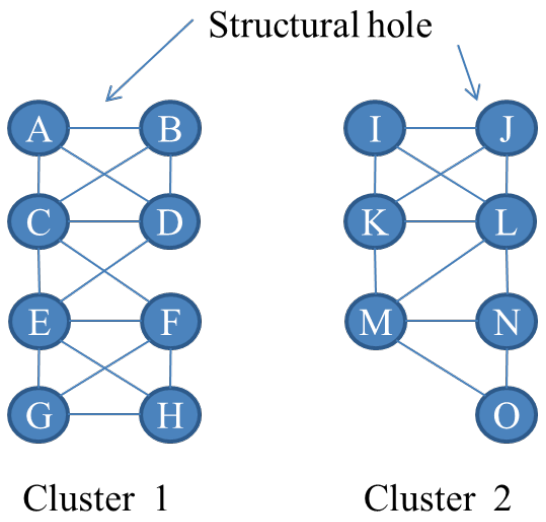

Figure 2 – A structural hole

It has long been recognized that one's position in a social network can play a very important part in one's career success [3]. However, on the part of the participants themselves (as opposed to those who study them), this understanding is more or less inchoate. As these concepts enter more and more into the mainstream due to the success of online social networking platforms such as Facebook and LinkedIn, we expect that individuals will become more aware of the role such networks and their place within the network can play in their career success. Further, we expect that they will purposefully cultivate those ties which will benefit them, and attempt to suppress ties among others which would hurt them. Since cultivating ties which might be advantageous is time consuming, any one individual can only cultivate a limited number of ties, thus part of the active process of improving his social capital might be the downgrading (strong tie to weak) or jettisoning those ties which are less advantageous. The ultimate goal of the research described in this paper (preliminary work) is to develop software tools to support this purposeful manipulation of one's place in social networks in order to support career advancement.

The rest of this paper is structured as follows. Section 2 sketches our main research goals in the area of social network analysis and section 3 presents future research and conclusions.

II. PURPOSEFUL MANIPULATION OF SOCIAL NETWORKS

Much research has been done on the analysis of social network structures as they exist at a moment in time or as they evolve over time. Less study has been done, however, on the purposeful cultivation and manipulation of the social network structure of an individual in order to enhance the career opportunities of that individual and/or maximize his opportunities in an organization.

Podolny and Baron [3] examined how the structure and content of individuals' networks in the workplace affect intraorganizational mobility. They found that an individual's mobility is enhanced by having a large, sparse network of informal ties for acquiring information and resources and that well-defined performance expectations are more likely to arise from a small, dense network of individuals. For the purposes of the present research, the first of these findings is most important. We would like to empower individuals to develop and cultivate such large, sparse networks of informal ties.

With the rise of online social networks, software tools to manipulate those networks have been developed. For example, Vizster [9] is a tool for end-user visualization, navigation, and exploration of large-scale online social networks. It builds upon familiar node-link network layouts to contribute techniques for exploring connectivity in large graph structures, supporting visual search and analysis, and automatically identifying and visualizing community structures. In addition many GUI (graphical user interface) based software packages for online social network analysis have been developed such as Pajek [10] and UCINet [11].

In order to describe the social network being analyzed, it is necessary to classify the ties in the network as being either weak or strong. That this can be done in an automated way is demonstrated by [5] in which a predictive model was used to map social media data to tie strength. The model was exercised on a data set of two thousand social media ties from Facebook and achieved 85% accuracy in classifying the ties as either weak or strong. Another work on Facebook data is described in [4] in which distinctions are drawn between the different types of interactions users have on Facebook. One to one communications (receiving messages from friends) is associated with bridging social capital, but other uses are not. However, even using the site passively to consume news assists those with lower social fluency draw value from their connections.

In order to meet our requirements, the software we are developing should incorporate the functionality of the above-mentioned packages such as GUI and extensive visualization, navigation and exploration of large-scale online social networks, but it should do more to enable purposeful manipulation of an individual's social network for career advancement. First, it should attempt to construct the user's social network from multiple sources, both online social networks such as Facebook, LinkedIn and Google+, as well as informal social networks using information gathered from such sources as email logs, phone call records, organization charts, etc. Notice that except in exceptional circumstances, the software will not have complete access to data such as email or phone records, due to privacy and legal requirements. For these sources, it is more likely that the software will have access only to the Ego network (or a portion thereof) of the user – that is, that part of the social network consisting of the user (the "ego"), those nodes to

 ISBN: 978-1-61208-443-5

whom the ego is directly connected (the "alters") plus the ties, if any, among the alters. See figure 3 for an example of an ego network. Incorporating these multiple, possibly contradictory, likely incomplete networks into a complete network representing the individual's context in an organization is a major part of the research.

It will also be a part of the required functionality of the software we are developing to provide hints for the user, beyond just allowing for freeform navigation and exploration of an online social network. So, for example, after having integrated the various social networks from the sources available, the software should analyze both the social network as a whole (representing the individual's organization) as well as the user's place in the network. It should then point out, for example, structural holes in the network, offering hints on how the user can fill that structural hole by cultivating (weak) ties with other employees. Since there are likely to be many such possibilities in a large organization, the opportunities will have to be prioritized by the system, possibly involving user interaction to clarify information such as the roles that the user and others play in an organization. A plan for cultivating ties might be generated.

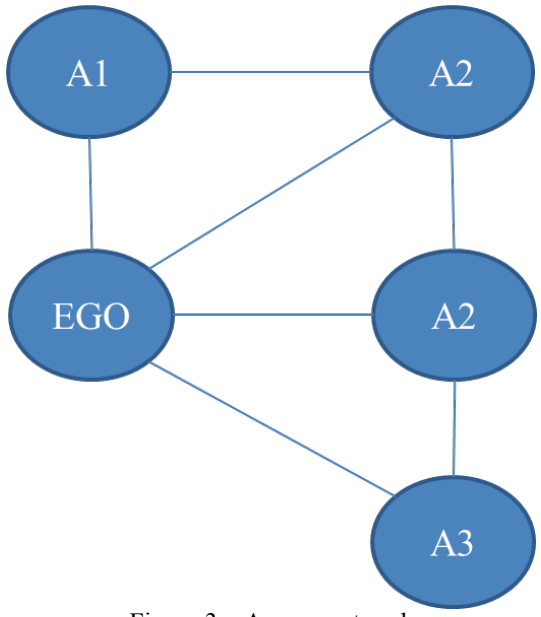

Figure 3 – An ego network

The overall data flow of the proposed system is shown in Figure 4. In the following paragraphs we give a very hiogh level, conceptual description of the system. The algorithms and data structures which will be used in the actual implementation of the system are actively under investigation and will be incorporated as the research proceeds. The input to the system consists of all of those pieces of information which will be used to construct the user's social network in the context of the organization in which he works. This will include online social networks such as Facebook, LinkedIn and Google+ (probably delimited to those contacts who are relevant for the career advancement objective), ego networks for the user which might be constructed by scraping data from the user's contact list, email client, phone records, etc., and other types of documents such as organization charts which can help to fill in those parts of the social network which the other two collections of information might miss. It is expected that this information will be incomplete, overlapping and contradictory. The first module of the system attempts to disambiguate and flesh out the network as much as possible automatically. The output of the first module is a preliminary aggregate social network for the user (preliminary because it is not expected that the fully automatic system will be able complete the network without manual intervention).

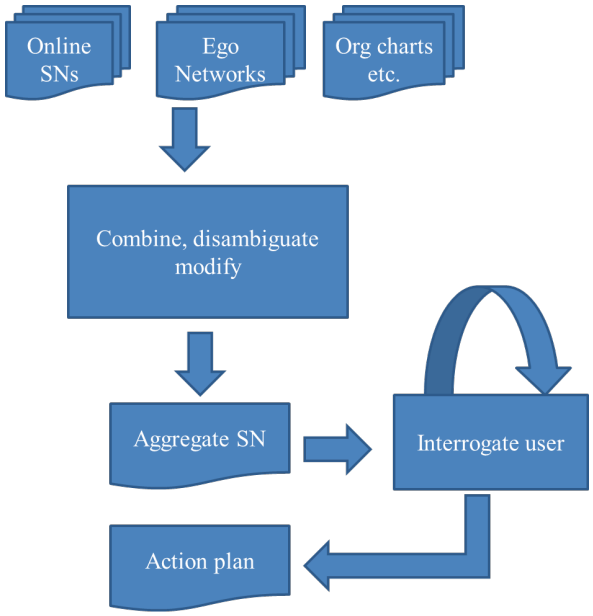

Figure 4 – High-level system data flow

The next module of the system will carry out a number of rounds of interrogation of the user. It will ask the user to correct any errors in the preliminary social network, performing such tasks as aggregating nodes which represent the same actor, if such has not been correctly performed by the automated portion of the system. The user will also be asked to fill out any missing information – such as roles for individuals which can help with the network classification algorithm and prioritization of equally useful ties in the social network. The user may also enter his career goals and any other information which may help the system produce the desired output. This process is an interactive one, and proceeds in a loop until a desired level of refinement is reached.

The final output of the system is an action plan (or a set of action plans) which can be employed by the user to enhance his social capital (for the advancement of his career), for example by filling structural holes, cultivating a denser network of strong ties in a department in order to increase trust, and hence productivity, in the department, etc. Note that the action plan (or plans) which are the final result

 ISBN: 978-1-61208-443-5

of the process will normally be acceptable to the user, since if they weren't, the previous stage would just go through one or more additional rounds of refinement.

III. CONCLUSIONS AND FUTURE RESEARCH

This paper has introduced my current work in progress research in the area of social network analysis for career advancement. I am currently at a very early stage in this research. The theme of the future research has been chosen, and currently available social network analysis software has been chosen, installed and tested for suitability. Sample data sets have been installed and tested.

The immediate next stage of the research will be to identify a set of social network data that can be used for an empirical study. Possibilities include Facebook or LinkedIn data sets, email data for an organization, cell phone trace data, etc. The use of at least some of the data sets will raise privacy and legal issues, so these will need to be studied as well. In the extreme case, simulated data may need to be used.

The overall structure of the system has been constructed, as outlined in the previous section, however specific algorithms and data structures need to be chosen. An algorithm for integrating diverse social networks, some of which may be incomplete and which may contain contradictory information, will be an interesting topic of future research. We are currently investigating the possibility of using an ontology-based approach in the part of the system.

An interesting question which might be a topic of future research is how the widespread adaption of tools such as those proposed in this paper would affect the social networks of organizations in the long term. Several researchers have looked at similar questions for the evolution of social networks. Burt, Merluzzi, and Burrows [7] analyzed network volatility as something akin to the hum of a running engine. People active in a network produce vibration and wiggle where the connections and the network structure around these people changes frequently. They distinguish four dimensions to network volatility (churn, variation, trend, and reversals), measure them with panel data on a population of bankers, and then add them to analysis predicting compensation from status and structural-hole measures of network advantage. They find that volatility creates a slope adjustment that enhances the returns to network advantage. They identify two stability traps that destroy advantage, but the key is not to avoid the traps so much as to avoid them in a particular way. The volatility that enhances is reversal. Bankers who go through reversals were shown to enjoy significantly higher returns to their network advantage.

Even more pertinent for our research, Buskens and van de Rijt [8] examine the question of whether those who strive to fill structural holes can gain and maintain an advantage over time. Burt's informal treatment and economic models of information network evolution suggest as equilibrium network the star, in which a single broker acquires all of the access and control benefits. The work of the authors, on the other hand, shows that if everyone is seeking the same type of advantage, adding beneficial links and removing costly ones, the predominant equilibrium turns out to be the "balanced complete bipartite network." Paradoxically, this network,– in stark contrast to the star – distributes benefits evenly, so no one has a structural advantage. So, if the tools we propose were adopted universally, they would not result in an advantage for anyone! Luckily, such a prospect is far in the future (if it is ever achieved).

ACKNOWLEDGEMENTS

Timothy Arndt's research was supported by a Dean's Faculty Development Grant from the Monte Ahuja College of Business of Cleveland State University. Cleveland State University MCIS student Pranjal Shah helped with the installation and testing of the social networking software.

REFERENCES

[1] D. Easley and J. Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, New York: Cambridge University Press, 2010.

[2] M. Granovetter, Getting a Job: A Study of Contacts and Careers, University of Chicago Press, 1974.

[3] J. Podolny and J. Baron, "Resources and Relationships: Social Networks and Mobility in the Workplace," American Sociological Review, vol. 62, no. 5, July 1996.

[4] M. Burke, R. Kraut, and C. Marlow, "Social capital on facebook: differentiating uses and users," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11), ACM, 2011, pp. 571-580. doi:10.1145/1978942.1979023

[5] E. Gilbert and K. Karahalios, "Predicting tie strength with social media," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09), ACM, 2009, pp. 211-220.

[6] R. Burt, Structural Holes: The Social Structure of Competition, Harvard University Press, 1992.

[7] R. Burt, J. Merluzzi, and J. Burrows, "Path dependent network advantage," Proceedings of the 2013 conference on Computer supported cooperative work (CSCW '13), ACM, 2013, pp. 1-2. DOI=10.1145/2441776.2441778

[8] V. Buskens and A. van de Rijt, "Dynamics of Networks if Everyone Strives for Structural Holes,"American Journal of Sociology, Vol. 114, No. 2 (September 2008), pp. 371-407

[9] J. Heer, and D. Boyd, "Vizster: visualizing online social networks," Proceedings of IEEE Symposium on Information Visualization, 2005. INFOVIS 2005, pp. 32-39, 2005.

[10] W. De Nooy, A. Mrvar, and V. Batagelj, Exploratory social network analysis with Pajek. Vol. 27. Cambridge University Press, 2011.

[11] S. Borgatti, Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies, 2002.

 ISBN: 978-1-61208-443-5