

Research Project Objectives

Underground groups, be they benevolent, subversive, or criminal (dark) networks, often explicitly advise their members to reduce their distinguishing features. The handbook of the infamous hacker group Anonymous advises members explicitly to "blend in with the crowd, disperse into the stream. Keep a low profile. Don't try to be special". On the other hand, one's position in the social network is an important determinant of one's influence, since it determines the efficiency of information propagation. This raises a trade-off between the security and the influence of key figures in the network. In our project we intend to study this trade-off and the problem of hiding in social networks.

Centrality measures are a well-established method of analysing social networks in order to identify key nodes. IBM's Analyst's Notebook, network analysis software used by multiple police and law-enforcing agencies all over the world, implements degree, closeness and betweenness centralities. Our main goal will be to disguise importance of the chosen source node in the network, i.e. lower all major centrality measures of his, so that adversary observing the network would not consider him a worthy target. To do that, we will modify the structure of the network, i.e. we will add or remove edges between its nodes.

Were that the whole problem, the solution would be easy - simply cut all connections between the source node and the network. However, that would deprive the node of any possibility to affect activities of the network or use it to gather information. Thus, we introduce an additional requirement. We want influence of the source node after the disguising process to be at least as high as before it.

Basic research

Finding an optimal way to disguise one's importance in a social network seems to require not only a vast amount of computation, but also knowledge about the structure of an entire network. However, assumptions like these are usually unrealistic for real-life social networks. Despite being a part of an enormous social structure, one usually possesses knowledge only about direct vicinity. We plan to find a way to disguise one's importance in network, considering settings with partial knowledge and limiting oneself to local changes.

There is also an alternative approach to the problem. We want to investigate, whether - instead of transforming already existing network - it is possible to create a new network, in which the source node maintains low values of centrality measures, but high influence. Assuming that third party analysing the network have resource to take up actions against some, but not all members of the network, that would grant the source node safety.

In some settings a single node can be a part of multiple separate networks. People can use many different media to communicate with various groups of their associates. We plan to investigate, how being part of many networks at once affect the hiding problems. Another approach to measuring node's importance in network are group centralities, allowing to compute centrality of an entire group of nodes. We intend to investigate a way for such a group to avoid being detected in the social network.

Another line of work is studying the opposite problem. Is it possible to identify the nodes that underwent disguising process? Can history of additions and removal of edges in a social network expose nodes that tried to disguise themselves? We plan to investigate alternative ways - other than just computing the influence - to identify influential nodes with exceptionally low centralities.

Significance of the project

Inspiration of our project was the problem of the formation of civil society in China. Despite hopes of many, the almost thirty years of an unprecedented economic growth of China has not eroded the fundamentals of the authoritarian political regime in Beijing. Economic developments of the population inevitably puts pressures on the central and local governments towards democratisation. Nevertheless, it is not the economics but rather the emergence and popularization of the Internet that poses the toughest challenge to the Chinese regime. This medium is used by tens of thousands of activists and political bloggers throughout the country as the only available effective medium of free speech. The government answers by resorting to censorship. Repression methods range from ad hoc controlling the message put on-line, removing it entirely to permanent bans from a particular service, arrests and imprisonments. The question that we deal with in our project is how a blogger can decrease his probability of getting caught without curbing his influence power.

So far analysis of the social networks focused on identifying key nodes of the structure. We look at the problem from different angle and reverse it. Inspired by the work on development of the civil society in China, we assume the perspective of an individual being a part of the network, rather than entity analysing it from the outside. Instead of finding key node, we want to help him avoid being detected. As the need for privacy on the Internet becomes the increasingly vital issue in today's society, results of the project might be of interest not only to political activist, but also to everyone who extensively uses social media sites.

To our best knowledge, we are the first to introduce the issue of hiding in the social network in this form. This can be a subject to research both in theoretic (investigating complexity of the problems and devising optimal algorithms) and in simulation (confirming theoretical findings and testing heuristic solutions) aspects. We believe that it can be an exciting new type of problems to study in social network analysis research.