Community Detection in Social Networks via Graphical Game

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a project proposal for STATS375, Winter 2010-11

January 17, 2011

1 Background

Communities are regarded as an important tool to understand and represent social networks. By nature, the rigorous definition of a community has not existed and many researchers have proposed their own definition of community or own algorithm for finding communities. The most prominent advance among the recent works is the concept of modularity by Newman et al. [New06] After Newman et al., extensive amount of researches has focused on the community detection of the optimization of modularity. Though mathematically elegant, community detection solely by optimization of modularity does not provide clean intuitive explanation about the formation of communities. In social networks, each node is individual person, who makes one's decision actively, but most of researches did not focus on the motivation of individuals.

2 Community Detection via Graphical Game

Recently, Wei Chen et al. [CLSW10] proposed a game-theoretic framework to view community detection. Wei Chen et al. [CLSW10] proposed the structure of a graphical game of community formation, where the graph of the game is the same as the graph of a social network, and each node's payoff increases with the number of communities that the node shares with the node's neighbors. They proved the existence of pure Nash equilibria and proposed a greedy-hill climbing algorithm to reach a "local" equilibria. As game-theory has been proved to be powerful tool to explain individuals' collective behavior, it would provide intuition about why and how communities are formed between individuals. In this project, I will explore further possibilities of applying graphical game to community detection.

3 Directions

3.1 Implementation of Wei Chen et al.

I will begin with implementing Wei Chen et al.'s method to detect communities. I will reproduce the same benchmark graphs as in [CLSW10], and check whether the method works as well as in [CLSW10]. Also, I will test the method in different benchmark graphs and evaluate performance.

3.2 Finding approximation of pure Nash equilibria

[CLSW10] called the equilibria they found a "local" equilibria in the sense that each individual is allowed to change its policy by small amount. In the project, I will try to find pure Nash equilibria of the game. In particular, I will refer to the recent achievement in reduction of a graphical game to Markov networks, [Kea07, DP06] and apply several techniques for approximate inference of Markov networks.

3.3 Varying the structure of the game

[CLSW10] proposed the payoff that is similar to modularity. I will try different payoffs and evaluate their effects on the performance of the method.

References

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