Discover Community Structures in Static and Dynamic Networks

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With the development of computer technology, researchers are able to observe and collect enormous amount of data, where the independent and identical distributed assumption is violated. For example, in sociology, individuals in an organization interact with each other to change the underlying social structure; in biology, understanding the gene-gene interaction helps researchers to detect potential diseases and invent curing therapies; in politics, voters are mutually influenced before the election via private/public speeches and parades, which might ultimately change the election results. Study how individuals interact with each other from the data is crucial, and would lead to tremendous contribution to the society.

Centuries ago, mathematicians started to describe the interaction of objects with mathematical language in the field of graph theory. The concepts of vertices/nodes and edges are the cornerstone of graph theory. Vertex can be used to describe individual and edge is a way to portray interaction between a pair of vertices. Taking advantage of the accumulated discoveries in graph theory, statisticians are able to develop stochastic models to make inference of the data, which can be represented by network structures.

My main research goal is to develop statistical models to discover the underlying community structure in various types of network data, including a snap shot of a network and time-varying network. The word "community" is an intermediate concept between a single node and the whole network, and can refer to a partition, a block structure, etc. Additionally, I desire to make my models be feasible to large size data, so that gigantic networks, e.g. social network, can be analyzed using my contributed methodologies.