Title: Analysis and Actions on Graph Data

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Abstract:

Graphs are commonly used for representing relations between entities and handling data processing in various research fields, especially in social, cyber and physical networks. Many data mining and inference tasks can be interpreted as certain actions on the associated graphs, including graph spectral decompositions, and insertions and removals of nodes or edges. For instance, the task of graph clustering is to group similar nodes on a graph, and it can be solved by graph spectral decompositions. The task of cyber attack is to find effective node or edge removals that lead to maximal disruption in network connectivity.

In this talk, we focus on the following topics in graph data analytics:

1) fundamental limits of spectral algorithms for graph clustering in single-layer and multilayer graphs
2) efficient algorithms for actions on graphs, including graph spectral decompositions and insertions and removals of nodes or edges
3) applications to deep community detection, event propagation in online social networks, and topological network resilience for cyber security

For (1), we established fundamental principles governing the performance of graph clustering for both spectral clustering and spectral modularity methods, which play an important role in unsupervised learning and data science. The framework is then extended to multilayer graphs entailing heterogeneous connectivity information.

For (2), we developed efficient algorithms for large-scale graph data analytics with theoretical guarantees, and proposed theory-driven methods for automatic model order selection in graph clustering.

For (3), we proposed a disruptive method for discovering deep communities in graphs, developed a novel method for analyzing event propagation on Twitter, and devised effective graph-theoretic approaches against explicit and lateral attacks in cyber systems.