Methods, Analyses, and Applications of Multilayer Temporal Link Prediction in Networks

Xie He

Abstract

Many applications stem from the possibility of accurately predicting links in various types of networks. In this thesis, we present methods, analyses, and applications for static, temporal, and multilayer networks. The first part of this thesis demonstrates how static network features serve as efficient and accurate predictors for link prediction in temporal networks. It includes an ensemble learning method we developed and presents experimental results on 90 synthetic stochastic block models and 19 real-world datasets. The second part closely follows, showcasing 20 different sampling methods and their effects on nine different link prediction algorithms for 250 real-world networks across 6 different domains. The third part of this thesis focuses on the analysis of hypergraph modeling and inference for parameters, emphasizing their significance in hypergraph link prediction. Results are demonstrated for 27 real-world hypergraphs of various sizes, some of which containing up to millions of nodes and edges. The last part of this thesis summarizes two applications of link prediction: one in cancer networks and the other in social networks. These applications demonstrate the broad versatility of link prediction algorithms.