ABSTRACT

In recent years, online social networks have become important platforms for a wide variety of applications like information propagation, opinion exchange, connecting to friends etc. Such dynamical processes are driven by influence between the corresponding users. Influence, however, is not an observable quantity and strongly depends on the context and the relationship between the users. In this thesis, we focus on influence modeling and estimation on two different problems: (i) link prediction and (ii) opinion dynamics in social networks.

Link prediction: A link prediction (LP) algorithm is given a graph, and has to rank, for each node, other nodes that are candidates for new linkage. Traditionally, LP techniques often focus on global properties (graph conductance, hitting or commute times, Katz score) or local properties (Adamic-Adar and many variations, or node feature vectors), but rarely combine these signals. Furthermore, neither of these extremes exploit link densities at the intermediate level of communities. In this thesis, we describe a discriminative LP algorithm that exploits two new signals. First, a co-clustering algorithm provides community level link density estimates, which are used to qualify observed links with a surprise value. Second, links in the immediate neighborhood of the link to be predicted are not interpreted at face value, but through a local model of node feature similarities. These signals are combined into a discriminative link predictor. We evaluate the new predictor using five diverse data sets that are standard in the literature and report on significant accuracy boosts compared to standard LP methods.

Opinion dynamics: Social media and social networking sites have become a global pinboard for exposition and discussion of news, topics, and ideas, where social media users often form their opinion about a particular topic by learning

about it from her peers. Therefore, the influence that one user exercises on other plays a key role in opinion evolution of the latter. In this thesis, we offer two models for opinion dynamics. The first one which is a discrete time model aims to capture the informational influence between users, which controls the dynamics of opinion across users. Our second opinion model is a continuous time probabilistic dynamical suit which also captures the temporal influence that regulates the rate of conversation in social network. Finally as an application, in this thesis, we propose a novel formulation of opinion shaping, where a set of influential users are incentivized in order to curate the opinions of the other users in a desired way. Results on both synthetic and real datasets show that our opinion models outperform the existing baselines in predicting opinions in future. Furthermore, our shaping framework can accurately determine the quality of a set of control users as well as shape the opinion dynamics more effectively than several baselines.

Keywords: Social network, influence learning, link prediction, opinion dynamics.