Modeling the Diffusion of Preferences on Social Networks

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Abstract

Issues about information diffusion on social networks has been studied for decades. To simplify the analysis, most models consider the propagated information or media as single real values. Representing media as single values however would not suitable for certain situations such as the voter preference toward the candidates in an election. In such case, the representation would better be lists instead of single values as people sometimes can alter others' preference through toward objects social inference.

This paper studies the diffusion of preference on social networks, which is a novel problem to solve in this direction. First, we propose a preference propagation model that can handle the diffusion of vector-type information instead of only binary or numerical values. Furthermore, we theoretically prove the convergence of diffusion with the proposed model, and that a consensus among strongly connected nodes can eventually be reached with certain conditions. We further extract relevant information from a publicly available bibliography datasets to evaluate the proposed models, while such data can further serve as a benchmark for evaluating future models of the same purpose. Lastly, we exploit the extracted data to demonstrate the usefulness of our model and compare it with other well-known diffusion strategies such as independent cascade, linear threshold, and diffusion rank. We find that our model consistently outperforms other models.

1 Introduction

With the success of viral marketing, people see the power of crowd opinions, and believe that individual options or preferences could be affected by acquaintances even though individuals generally possess intrinsic preferences. For instance, in an election, people would argue and even attempt to convince others for their favorite candidates. With the rise of social networking service (e.g. Facebook and Twitter) in Web 2.0 era, people would create or reply posts to promote their favorite candidates. In such case, it is the preference toward a set of candidates that is propagated in a social network. Up to date we have not yet seen too many computational approaches with systematic and quantifiable studies on this issue. Nevertheless, being able to model the human preference does possess its own value in the real world applications. For instance, social scientists might wonder to what extent the opinions exchange among friends can affect each other's viewpoints toward an object. Campaign companies might inquire how to promote a candidate given a limited budget through a social network. Such questions are not easy to answer via a real-world user study, in particular when the network becomes huge.

Although the issues about information propagation on social networks have been studied for decades, many proposed models such as the independent cascade model, linear threshold model, SIR/SIS model, and heat diffusion model, unfortunately, assume the sources for propagation are either binary values or real numbers. They cannot be applied directly to solve our problem where it is a preference list that needs to be propagated on the network. The goal of our study, therefore, is to design a suitable framework that allows us to model the preference propagation on social networks.

To handle the information propagation such as the situation in election, we have realized several preferable properties for a suitable preference propagation model, namely *hyper dimensional media*, *input dependent*, *deterministic convergence*, and *consensus*. The properties are intuitively inspired by the natural real-world phenomena, and are summarized as the follows. First, we prefer the media (which represents preference toward candidates) propagated throughout the process being a real valued unit vector because democratically, individuals (or nodes) have equal right in casting votes. Second, the preference distribution should be affected sig-

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