**Research of Social Network User Behavior Preference Prediction Based on Social Influence**

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**ABSTRACT:** The development of internet and mobile communication technology makes the analysis of user behavior become a significant research area. And the popularity of all kinds of social networks provides massive and real data for analysis and prediction of user behavior. In this paper, considering the users’ social influence in online social network, we proposed a framework of user behavior preference prediction based on social influence. Then given the existing assessment methods, we also analyzed and summarized the ways of evaluating the prediction model.

1 INTRODUCTION

Recently, there are many kinds of social network emerged, which are very popular with the masses of users. Social networks provide many kinds of services to their users such as games, instant messaging, dating. In the age of web2.0, the value of social network users is being released, every user could provide massive and real data through social network. The user-centered ideas constantly infiltrates various industries and fields which makes enterprises and governments realized the importance of analysis the behavior and preference of social network users(Shriver et al., 2013). Because the user behaviors in social network are reflections of users’ real thoughts, the analysis and prediction of user behavior and preference has become a popular research area.

The popularity of all kinds of social networks and intelligent terminals provides a new platform for users to communication and sharing, and the data generated from it is real, seasonable and giant which is the strong data foundation of user behavior analysis and preference prediction. There are many kinds of niche social platforms such as music, shopping, and photo etc., therefore, according to those different application, there also emerged many kinds of analysis and prediction frameworks. There is a trust prediction framework applied to user experience sharing community. In this framework, it firstly collects the user grades of the product and service experience, then builds the trust network of users uses the user grades and topics they interested in, and predicted the user behavior preference based on the user’s trust relationship (Scellato et al., 2011). Some researchers proposed another prediction framework which combined traditional collaborative filtering with social relationship. In this framework, it firstly collects the user grades of the product and extracts their social relationship, then finds the nearest neighbor users based on the traditional collaborative filtering method, and predicts the user behavior and preference through fusion the nearest neighbor users and user’s social friends(Liu and Hong, 2010).

However, the social network itself has some characteristics which could have negative effects on the behavior preference prediction. The consistency of user preferences usually has low accuracy, and the social influence often lack of diversity, those limits can all have significant effects on the accuracy and coverage rate of user behavior preference prediction. In this research, according to the problems that the behavior preference prediction now has, we propose a new framework and model to predict user behavior.

2 THE PREDICTION FRAMEWORK BASED ON SOCIAL INFLUENCE

In the prediction of user behavior and preference based on social influence, the first problem is mining the connected factors of user social influence. Firstly, we find the connected factors in the data that contains the social relationship, user preference and the user’s basic information.

The mathematical expression is as follows:

\[
g(G, P, U_{profile}) \Rightarrow (f_1, f_2, \ldots, f_k)\]  

(1)

G refers to social network, including the pitch point and user relationship, P refers to user reference,
like the label, keywords and topic in Weibo. \( U_{\text{profile}} \) refers to the basic information of users, such as gender, age and profession. Through these information we can extract connected factors to describe users’ social influence, such as users’ degree and topic distribution. Through those connected factor, we can build the social influence calculation and propagation model, and get social influence between users.

\[
(f_1, f_2, \ldots, f_k) \Rightarrow SI
\]  

SI refers to the social influence matrix between users, it is a square matrix which the amount of user is \( N \). \((i, j)\) refers to the influence that user \( u_j \) gives to user \( u_i \). In common situation, \((i, j)\) and \((j, i)\) are not equal, because in most circumstances the influence between users is not symmetric.

As a main character of social network, social influence has important effects on users’ behavior, mind and innovation. The prediction based on social influence contains two main parts, the calculation of social influence and the transmission of social influence in the network. The calculation of social influence needs to measure the status, location and importance of each user in social network. There are already network node importance calculation methods such as node centrality, PageRank, LeaderRank etc., which can be the calculation model of social influence. In this research, we recommended to use only the users’ local network information, and could develop a calculation method of social network which has diversity. In this way, we can avoid the shortcomings of existing methods. As to the transmission of social influence, on account of the multiple path between users, we need to consider different propagation path, such as the shortest path method, maximum transmission path method, and minimal transmission path method(Breese et al., 2015).

The framework of user behavior preference prediction model is given in figure1. The framework is including the input data, mining of social influence connected factor, calculation of social influence, transmission of social influence, and the chosen of nearest neighbor which has biggest influence on users, and the prediction of user behavior and preference based on social influence of the nearest neighbor.

The input data of this framework contains two parts: user interaction network model and user behavior data. User interaction network model refers to the social relation network built by mining the potential social relation and calculating user preference. It enriched the social relation, and distinguished the tightness of the relationship between different users, therefore the analysis of user behavior will be more accurate. In addition, user behavior data mainly contains the interaction between users, such as user comments and forward, users’ click, browse, and collection etc., and the evaluation to product.

We need chose the connected features of user social influence from the input data, then build model to calculate users’ social influence. It considered different factor to be able to accurately measure the user's social influence. However, there are also many users who don’t have direct social relation which we need to apply the idea of information transfer. The social influence could be transferred in social network, user can influence their indirect friends(Walker, 2011). Considering the social influence will decay quickly over time, and small impact can be ignored, we can use a shortest and largest travel path path strategy to calculate the spread of social influence.

Through the calculation of social influence, we can get the social influence of indirect neighbors in social network, one specific user could be influenced by many others who isn’t there direct social network friends through the spread of social influence. But the incidence of the influence could be different. Therefore, considered the time cost and accuracy of the calculation, we need to choose social relations that the social influence of which could be above a certain threshold value. Then we could predict the user behavior through this certain social influence.

3 THE ASSESSMENT OF THE PREDICTION MODEL

The prediction of user behavior and preference could have a big help to enhance customer experience, and will be of great importance to enterprises and society. However, there are many kinds of differences in the data input, parameter control, theoretical basis and hypothesis of the prediction model. Therefore different user behavior prediction algorithms and models suit different application scenarios. Even to the same application,
there could be many solution which have obvious difference.

After the build of the prediction model, we need to assess the model use prediction algorithm evaluation model. Through the assessment of the prediction algorithm and model, we could choose the suitable prediction algorithm for specific situation. An effective assessment method could help researchers find the advantages and disadvantages of different prediction algorithm, therefore help them to enhance their methods.

The framework of the assessment of the prediction model is in figure 2.

![Figure 2. The framework of the assessment of the prediction model.](image)

In the circumstances of social network, there are different kinds of output results in prediction model based on social influence. We use the output of different prediction algorithm as the input of the assessment model, through the calculation of the assessment model, we can get the assessment results. The existing assessment model contains accuracy, recall rate and mean absolute error, and the results is a comprehensive assessment. According to the demand of the application scenario, we could set different limit conditions, so that we can compare the differences of prediction algorithm from a micro level, and it could make the prediction have more realistic significance.

4 CONCLUSION

The social influence and propagation a main attributions of social network, the user's behavior, ideas, decisions are often affected by their social friends, the social influence will be propagated along with the social relationships. Therefore, through the understanding of social influence, the trend of user behavior can be analyzed and predicted. In the further research, based on the framework of the prediction model, the predictive results of user behavior based on social influence should be evaluated by a visualized evaluation method which could compare different prediction results from a micro level.

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