

## Collaborative Filtering Recommendation Algorithm

Miao Duan

Jilin Jianzhu University, Jinlin 130118, china  
279332269@qq.com

**Abstract.** Aiming at the problems that the existing model-based collaborative filtering algorithm has low recommendation accuracy and small recommendation coverage, we propose a collaborative filtering recommendation algorithm based on the trust propagation by introducing the trust information of social network to extend the matrix factorization-based recommendation model. We first design a set of trust propagation rules based on the direct trust relationships of the social network, so as to propagate the trust relationship in the social networks, and get to quantize the new trust relationship.

**Keywords:** Recommendation, Trust Propagation, Matrix factorization

### 1 Introduction

The traditional collaborative filtering (CF) [1-3] recommendation algorithm regards item rated information by system users as the only information source, ignoring the trust relationship among users in the online social network. So the recommendation system can't recommend different merchandise items to target users according to different users having unlike social relationship [4-5]. Likewise in the reality, in the virtue network world, users have different social relationship. Their preferences and demands differ greatly. With popularity of online social network, it becomes a hot topic in the recommendation system field about how to use such trust relationship to solve problems faced by traditional collaborative recommendation methods [6-7].

In recommendation algorithms, matrix decomposition technic is used to deal with massive data set as to reduce the dimension [8-9]. Moreover, the technic has been widely applied in model-based collaborative recommend methods. Koren [10] et al. introduced a recommendation algorithm based on matrix decomposition, not considering the trust relationship among users. Salakhutdinov [11] et al. suggested similar method based on probability matrix decomposition, which neither considers the trust relationship among users. Ma et al. proposed on the basis of social network a collaborative recommendation method based on matrix decomposition. It incorporates the direct trust relations among users, but overlooks the transition of them, leading to narrow coverage of the algorithm [12].

## 2 Related definitions

Fig. 1 is a social network, a non-binary trust network. In the paper it studies a binary trust network, that is, the trust value is not 0 but 1. In the network, there are six nodes, each node for a user. Each directed edge stands for one social trust relationship. Question mark in the picture means trust degree after trust transition between user  $u_1$  and  $u_3$ .

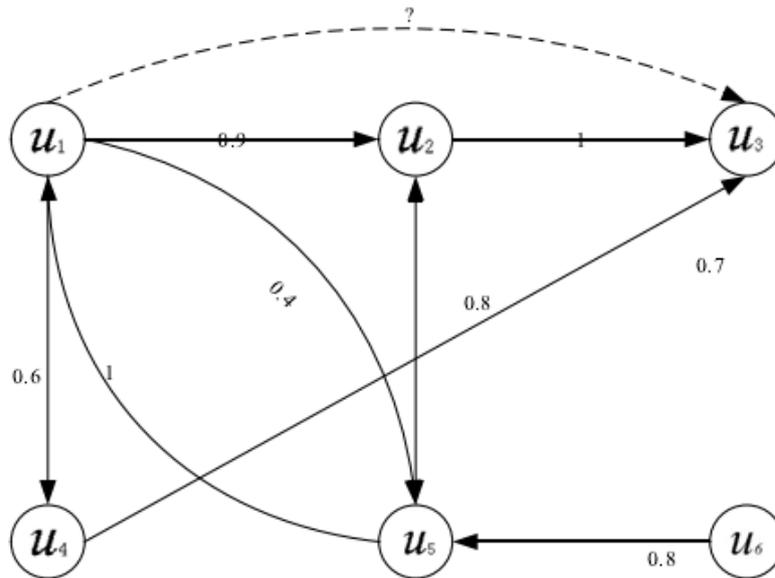


Fig. 1. Social network

## 3 Collaborative filtering recommendation model and algorithm based on trust propagation

The collaborative filtering recommendation model based on trust propagation involves the process of fusing into the recommendation the new trust relationship which derives through trust transition rules from the social and trust relationship among users. In other words, it utilizes direct trust relationship among users to elicit indirect trust relationship among new users, as to make current users match with more trust users and discover trust-ability among new users for eventually the improved recommendation accuracy of items.

The recommended model is divided into three parts: the original data processing, trust information recommendation, recommendation service.

The original data processing: this part is mainly to get the user-item rating data and user trust of user's rating data. First, for the system obtained data set is preprocessed, non-rating data needs to be quantified, score data needs to appropriate modifications, For example, deleted some aggressive attacker users data, the last obtained item-rating matrix and trust rating matrix.

Trust information recommendation: this part is mainly directed against the traditional collaborative filtering algorithms in the scoring matrix data are very sparse, and it is hard to calculate the similarity between users is proposed under the situation, because the trust degree and similarity are the same, can also be used as a recommendation algorithm right weight, So considered the use of trust to replace the traditional similarity as the weight of the final recommendation, the characteristics are:

One is the effective well integrated in trust relationship in recommended process;

The other is calculating transitive trust rating matrix after the user's trust score than the previous number more, no longer like the previous so sparse rating matrix.

Recommendation service: the main function of the part is the extraction of rating prediction data sets, generated recommendation list for the target user.

In addition, the model also contains one of the most cases, it is the target users in the user item-rating matrix directly score for the goal of the project, generated its recommended list.

## 4 Experiment Design and Discussion

The experiment adopts Epinions data set, collected from a famous e-commerce merchandise rating website. The data set statistics are listed in Table1, inclusive of two data sets frequently used by the recommendation system. Table1 shows the quantity of rated trust relationship among users. It can be deferred that the coverage of trust appraising is below 1%. The numerical score of user's rating about merchandise items is integral figure from 1 to 5. Such scores represent user's different fondness of items. Trust relationship among users can be rated 1 or 0. 1 means belief between two users, while 0 means no trust.

Epinions data set used in the experiment is rather sparse in terms of either user-item rating data or user-user trust relationship rating data. According to statistics, 48.4% of users in the set have less than five rating records, the density of rating matrix below 0.015%; 52.2% of user trust relationship rating records is below 5, the coverage rate of trust rating less than 1%. From Table1 it's noted that Movielens and Eachmovie are two most well-known data sets for the collaborative filtering recommendation system. Also based on scores of items, we can get scoring density of the two sets: 4.25% and 2.29%. But the experiment used Epinions data set instead of Movielens or Eachmoive data set because the latter two don't have user-user trust rating information.

**Table 1.** data set description

Data Sets	Users	Items	ItemsRatings	TrustRatings
Epinions	40100	149856	663478	377191
MovieLens	5060	3800	1111309	-
Eachmovie	68834	1578	3811789	-

## 5 Conclusion

This paper proposes a collaborative filtering recommendation algorithm based on trust propagation. Firstly, according to the propagation characteristics trust in social networks, presents a set of trust propagation rule, obtains the user between the indirect trust degree by direct trust degree calculation in the network, and to quantify the indirect trust. Secondly, simply introduce the matrix decomposition algorithm.

## References

1. Liu Jianguo, Zhou Tao, Wang Binghong. Research progress.progress in natural science, personalized recommendation system, 2009, 19 (1): 1-15.
2. Ma H, King I, Lyu M R. Learning to recommend with social trust ensemble. InSIGIR. 2009: 203–210.
3. Yuan Hanning, Zhou Tong, Han Yanni, Chen Yuanyuan. The collaborative recommendation algorithm based on MI clustering. Journal of Wuhan University (Information Science Edition), 2015,02:253-257.
4. Cai Zhiwen, Lin Chien Chung. Trust oriented social commerce collaborative filtering recommendation method. Computer applications, 2015,01:167-171.
5. Jia Zhongtao. Design and implementation of collaborative filtering algorithm based on the film of personalized recommendation. Software guide, 2015,01:86-88.
6. Fang Qian, Du Jiansheng. Research on collaborative filtering recommendation trust model considering P2P environment. Tech Information Development economy, 2015,01:122-124.
7. Bi Xiaoru. Project similarity fusion collaborative filtering recommendation algorithm. The application of computer system, 2015,01:147-150.
8. Li Liang, Zhang Haining, Li Zongbo, Chen Jiayu. Application of collaborative filtering recommendation algorithm fusion user attributes in government procurement. Journal of Chongqing University of Technology (NATURAL SCIENCE), 2015,01:76-81.
9. Ke Liangwen, Wang Jing. A collaborative filtering recommendation based on user migration characteristics. Computer Engineering, 2015,01:37-43.
10. Koren Y, Bell R, Volinsky C. Matrix factorization techniques for recommender systems. IEEE Computer, 2009, 42(8): 30–37.
11. Salakhutdinov R, Mnih A. Probabilistic matrix factorization. InNIPS 2008, 20: 1257-1264.
12. Xu Yabin, Liu Chao, armed. The user's interests and recommend trust domain based recommendation. Micro-blog Telecom Science, 2015,01:13-20.