Designing a Trust-Based Recommender System in Social Rating Networks

Maedeh Kiani Sarkaleh1, Fatemeh Khoshnood2
1) Department of Information Technology, Payam e Noor University, Iran
2) Sama Technical and Vocational Training College Islamic Azad University, Lahijan Branch, Lahijan, Iran

maedeh.kiani@gmail.com; khoshnood49@yahoo.com

Abstract

One of the most common styles of business today is electronic business, since it is considered as a principal means for financial transactions among advanced countries. In view of the fact that due to the evolution of human knowledge and the increase of expectations following that, traditional marketing in electronic business cannot meet current generation’s needs. In order to survive, organizations have to correct and even change their advertisement strategies along with changes, facts and behaviors of their customers. In order for this and considering unique characteristics of social networks in obtaining and evaluating customer’s behavior, there will a chance for the organization to reach its goals through performing such a business on social networks. In this article, a trust-based recommender system in Social Rating Networks (SRN) is designed in order to recommend an article to the user through receiving user ID and evaluation of related characteristics. A big real data set, Epinions, is used in the database of this system. According to the evaluation performed in this system, 99.01% of users studied the articles recommended by system and an average ratio of articles studied by each test sample to the recommended articles was 87.57%.

Keywords: Social Rating Network, Trust-Based Recommender System, Epinions Database

1. Introduction

A recommender system or a recommendation system (also known as recommender/recommendation platform or engine) is an information filtering system that seeks to predict the "rating" or "preference" a user will give to an item, and provide users with a variety of suitable suggestions. Recommender systems aim to recommend items that quite likely are interesting to users to boost the variety and sale of the items as well as improve user satisfaction and engagement. Recommender systems have two major functions: learning the user’s interests from traces of interaction with that user, and making very personalized offers they have never searched for. These systems speed up searches and make it easier for users to access the content they’re interested in.

Today, recommender systems are invaluable in helping users make decisions or set preferences or ratings for items of their main interest, from a large collection, preserving their involvement and increasing sale rates [1].

There are four main approaches in recommender systems, including: collaborative filtering, content-based filtering, knowledge-based filtering and hybrid approach.
Collaborative filtering selects items based on the similarities between the ratings of different users. Content-based filtering relies on the similarities between the content description of an item and the user’s preferences. In knowledge-based filtering, the algorithm takes into consideration the knowledge about the items, such as features, user preferences asked explicitly, and recommendation criteria. Hybrid filtering is a combination of collaborative and content-based filtering that avoids problems caused by working with just one approach. Currently, collaborative filtering is the most successful and widely used approach [2], [3].

Nowadays, internet and web services are growing rapidly. In this regard, digital social networks play major role in people’s real life. Actually, digital social networks are communicational networks which apply the internet as a means to supply communication among individuals. Therefore, with the increasing users of these networks, exploitation in such huge scale can present a better and more effective use of hidden potential of such networks [4]. Results can be applied in different courses like; social analyses, finding dangerous groups (terroristic groups) and business objectives especially; marketing [5] and advertisement [6].

One can extract data from these networks to discover commutative subjects of individuals and then provide ads related to these subjects. Subjects show users’ tendency, so the obtained ad will correspond to user’s tendency, as well. It is expected that this method is more successful compared to the old ad system. Before, ads were sent to all users, it is not important what the content of ads is and who receives them. It seems that this system is much costly because each ad should be sent to all the users of the network. Besides, since there is no coordination between the ad and user’s tendency, most of them are ignored. Additionally, this issue can cause dissatisfaction for users and impose adverse effects on advertising.

In social networks, users are classified based on the subjects they communicate. The subjects are acquired through extracting data in that environment that show user’s tendency, and eventually, related ads are provided. Actually, finding individuals who seem to be more willing to accept their favorite ad, the system will be more successful bearing less cost, compared to the older method [7].

According to figure 1, social networks contain a wide range of different applications and web services. The major goal is to provide suggestions according to user’s interests and tendencies through extracting their communications in digital social networks.

Social networks have received much attention among researches and operators. Social network services e.g. Face Book, Over Cut, Flicker, and Live Journal have millions of users and help complicated communications among users.
In this regard, Carmagnola et al [8] suggested the evaluation of user's interest in an item (score) considering the strength of the relationship between the user and their neighbors as well as the level of interest created by an item to each neighbor of the target user. Beatty et al [9] carried out a comprehensive study on consumer's trust in E-commerce websites, emphasizing the organization and management of the website content to guarantee its trustworthiness. Artz and Gil [10] presented an overview of trust in on-line purchase using a computer science perspective.

Social networks bear complex communications and some dependencies among users and their characteristics which have been studied in social science since decades ago. With increasing access to on-line social networks, analyzing huge social networks has been of much interest recently. Research subjects include fixed analysis of social network structures [11], completion model of these structures during the time [12] [13], and analysis of comprehensive dynamics of social processes [14] [15]. The influences of characteristics on such networks, especially social influence and correlational influence, presented to understand and adjust recommender systems in social networks, are very important. Social influence drives individuals toward accepting their neighbors. Correlational influence leads individuals toward accepting the behavior of users with similar behavior in the past. The concept of correlational influence forms cumulative filtering principle [16].

In this article, the focus is on Social Rating Networks and besides, these networks are widely applied for trust-based suggestions [1] [17]. It is a Social Rating Network (SRN) where users can provide ratings about services and products and share them. These networks have major role in websites like; Epinions and Flixster.

The content of this paper is as follow: in section two, a trust-based recommender system in social rating network is presented. Section three explains how to create a dataset. Simulation results are discussed in section four. Finally, the paper concludes in section five.

2. Designing a Trust-Based Recommender System in Social Rating Network

The aim of this article is to design a trust-based recommender system in SRN network to provide aimed ads and suggest appropriate articles for users in a social rating network. In social rating networks there are two distinguishable behaviors expected from users: accepting an item for rating and accepting a rating value for that item. This type of network is different from other social networks in that they mostly consider activities related to the acceptance of items.

2.1 The Structure of Recommended System

Figure 2 shows general structure of a recommended system.
In this system, the user ID is used for suggestion. Therefore, in order to create a database, first, the user ID and its trustable individuals are classified. One of these classifications related to ID 6864 is as follows:

\[ \text{ID6864} = [375 \ 1422 \ 3204 \ 609 \ 2920 \ 1010 \ 379] \]

This classification shows that, users with IDs 375, 1422, 3204, 609, 2920, 1010 and 379 are trustable individuals for the user with ID 6864.

As is displayed in figure 2, recommended system contains two sections, a recommender system and a rating system, introduced in the following.

2.1.1 Recommender System

According to figure 3, after user ID is received as the system input, trustable individuals of the system in existing database are identified. Then, considering the articles studied by these individuals and studying their scores, articles with highest scores received from user's trustable individuals are extracted and recommended to the individuals by the system.
Among all the articles studied, those with highest scores received by user’s trustable individuals and expected to be of their favorite and need, are considered as system output for the user.

2.1.2 System Evaluation

The evaluation implemented in this system, according to figure 4, is explained, from two viewpoints and within three steps, as follows:

The first viewpoint includes one step. In order to conduct evaluation in the database, it is considered whether the articles suggested to the individuals are among those studied by them or not. If yes, it is concluded that the designed system provided an appropriate suggestion for the user. Second viewpoint includes two steps i.e. the score the article, if studied by the user, received. The results, in this viewpoint, identify the quality of suggestions in this system.
3. Database

Generally speaking, one obstacle to analyze social network, especially social rating networks, is the lack of easy access to datasets for public. Meanwhile, Epinions dataset is one evaluable dataset of social network accessible in order for this type of networks to be analyzed. Epinions.com is a consumer evaluable and analyzable social network website launched in 1999. In Epinions, visitors can study some evaluations on some items which help them choose next items. Items belonging to Epinions are from different groups. As an example, these items may include digital cameras, music, book or articles.

In order to add comments, members register for no cost and start writing personal opinions including satisfaction or dissatisfaction. To post a comment, members, first, rank the items on a 1-5 rating scale. Members can rank others’ opinions as Very Helpful (VH), Helpful (H), Somewhat Helpful (SH), and Not Helpful (NH) or Off-Topic (OT), as well. This website aims at providing a basis for future customers about their expectations when purchasing a proper product and using it.

Members can also make decisions about their trustable or un-trustable individuals. All trust or distrust relationships form hierarchies known as Web of Trust (WOT). WOT is combined with a rating system on basis of which opinions are displayed to readers. WOT formula is secret [21], [22].

Epinions dataset applied in simulations include around 50000 users who evaluated 140000 items at least for once. General number of reviews is 660000 and the number of trust ideas provided is around 490000.

This dataset includes two files named Rating Data and Trust Data. Data rating file contains the scores given to the items by user. The format of each line and its limit of parameters are as follows:

\[
\text{User_id} \text{item_id} \text{rating_value}
\]

Ranges:
\[\text{User_id} \text{ is in } [1,49290]\]
\[\text{Item_id} \text{ is in } [1,139738]\]
\[\text{Rating_value is in } [1,5]\]

Trust data contains trust situations expressed by user and is explained as follows:

\[
\text{Source_user_id} \text{target_user_id} \text{trust_statement_value}
\]

Ranges:
\[\text{Source_user_id and target_user_id are in } [1,49290]\]
\[\text{trust_statement_value is always 1}\]

Due to the big size of this dataset to be implemented, 645 user IDs are selected randomly. Articles studied by selected users and the scores given to them corporate to the creation of a database. In order to evaluate the designed system, 101 samples are used.

4. Simulation Results

All the simulation was conducted in Matlab. As noted earlier above, user ID is received as system input and after user’s trustable individuals in existing dataset is identified and the articles studied by them are investigated and their scores are compared, articles with highest score are recommended to the individuals as system output. As an example, the user with ID 2812 was given to system as an input and the
system suggested articles number 11550, 659, 19680, 393 and 19681. In evaluation section of the system, the result was that among 5 articles recommended to the user, four were read.

In recommender system, after the article is recommended to user, it is investigated, in existing database, that whether these articles are among the articles studied by the individual or not and, if yes, what score it was given. If the answer to the first question is positive, given that the score given to the article is high, the suggestion contains a high quality. According to two viewpoints taken into consideration for system evaluation, section “first evaluation” is related to “first viewpoint of system evaluation” and sections “second and third evaluation” are related to two steps “second viewpoint of evaluation”.

4.1 First Evaluation

In table 1, the number of articles recommended to the user and number of articles studied are determined. This table shows that 100 people out of 101 i.e. 99.01% of users studied an article from recommended ones.

In figure 5, the ratio of the studied articles to the recommended articles related to samples are displayed. According to table 1, the average ratio of recommended articles to studied ones is 87.58%.

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4.2 Second Evaluation

In order to study the quality level of the recommender system, user satisfaction after studying the article is considered. In this regard, the number of articles with average plus score is extracted, results of which are displayed in table 2. The ratio of the average plus score articles to the recommended articles, is reported in figure 6. The average ratio is 78.82%. The high ratio shows the quality of the designed recommender system.

### Table 2 – Result of second evaluation

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Figure 6- The ratio of “average plus score” articles to the recommended articles
4.3 Third Evaluation

This evaluation shows the quality of the recommender system where total satisfaction of sample user is considered. If user is completely satisfied with the recommended article, it will receive the highest score (5), therefore, the number of articles with highest score by the sample user can show its perfect satisfaction. Table 3 shows the number of articles which received maximum score by the sample user.

According to table 3, 26 people out of 101 i.e. 26/101*100=25.74% didn’t give perfect score to any recommended article and the value obtained can show perfect satisfaction of most of users with at least one recommended article. Figure 7 shows the ratio of the number of articles with maximum score to the recommended articles and the result obtained is around 48.85%.

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Designing a Trust-Based Recommender …  

M. Kiani Sarkaleh, F. Khoshnoood

In this article, a trust-based recommender system is designed in social rating networks. In this system, Epinions dataset was used to create a database. This huge dataset contains 49290 user IDs and 139738 item IDs, due to the big size of which, to execute the suggested system, 645 user IDs were used to make the database and 101 samples were used to evaluate the applied system.

Importing user ID as the input, through searching for user’s trustable individuals in the existing database and studying the articles and their scores, the system recommends articles with highest score to the user. With the evaluation performed after system output is observed, it was found out that in all samples, the recommender system provided suggestion, and in 99.01% of cases, at least one suggested article was studied by the user. The average ratio of articles studied by each sample to the suggested articles was 87.58%. In addition, an average 78.82% of suggested articles received a score above the average by sample users.

Therefore, the suggested system recommended articles to the sample users which, in addition to be studied by them, resulted in their satisfaction as well. Eventually, our suggested system contains an appropriate efficiency in providing suggestions in social networks.

References


Figure 7 - the ratio of the number of articles with maximum score to the recommended articles

5. Conclusion

In this article, a trust-based recommender system is designed in social rating networks. In this system, Epinions dataset was used to create a database. This huge dataset contains 49290 user IDs and 139738 item IDs, due to the big size of which, to execute the suggested system, 645 user IDs were used to make the database and 101 samples were used to evaluate the applied system.

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