

# An Electronic Commerce Recommendation Algorithm Joining Case-Based Reasoning and Collaborative Filtering

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**Abstract.** With the rapid development of network, information technology has provided an unprecedented amount of information resources. It has also led to the problem of information overload. Electronic commerce personalized recommender systems represent services that aim at predicting a customer's interest on information products available in the application domain, using customers' ratings on products. Peoples' experiences often do not enough to deal with the vast amount of available information. Thus, methods to help find products of electronic commerce have attracted much attention from both researchers and vendors. Collaborative filtering technology has proved to be one of the most effective for its simplicity in both theory and implementation. The paper gives an electronic commerce recommendation algorithm combining case-based reasoning and collaborative filtering. Firstly, it uses case-based reasoning to fill the vacant ratings. Then, it produces prediction collaborative filtering. The presented algorithm combining case-based reasoning and collaborative filtering can alleviate the sparsity issue.

## Introduction

With the rapid development of electronic commerce and Internet popularization, the information technology has penetrated into every corner of our social life, is with hitherto unknown speed and the ability to change our life and working way, we are really in an "information explosion" era. In the face of the vast resources on the Internet, people often feel be at a loss what to do, not know what course to take, the emergence of the so-called "information overload" and "information lost" phenomenon. In view of all kinds of the information, only to rely on manual methods to collect and collate the required information is clearly not enough. So, automatic collection and all kinds of information become a challenge and opportunity for development of information industry is facing consolidation needed. Especially for the scientific research and teaching personnel speaking, with the increase of science and technology literature exists in electronic journals and online document form, how to make full use of existing network resources, from the electronic document complex in timely and accurately access the latest information technology and their research areas related to appear very necessary.

Collaborative filtering technology has proved to be one of the most effective for its simplicity in both theory and implementation. The paper gives an electronic commerce recommendation algorithm combining case-based reasoning and collaborative filtering. Firstly, it uses case-based reasoning to fill the vacant ratings. Then, it produces prediction of the target user to the target item using collaborative filtering. The presented algorithm combining case-based reasoning and collaborative filtering can alleviate the sparsity issue.

## Collaborative filtering personalized recommendation

At present, there is much information filtering model. A typical information filtering model should include general information input source, user model, user interface, filtering algorithm, as shown in figure 1.

Rule based system in general is the user preference and information resource using the same set of keywords, they allow the system administrator to set the rules according to the static

characteristics of a user and dynamic attribute, a rule is essentially a If- Then statement, rules determine in different situations such as how to provide different services, the utility model has the advantages of simple, the disadvantage is difficult to guarantee the quality of the rules, and cannot update rules, with the increase in the number, the system will become more and more difficult to manage.

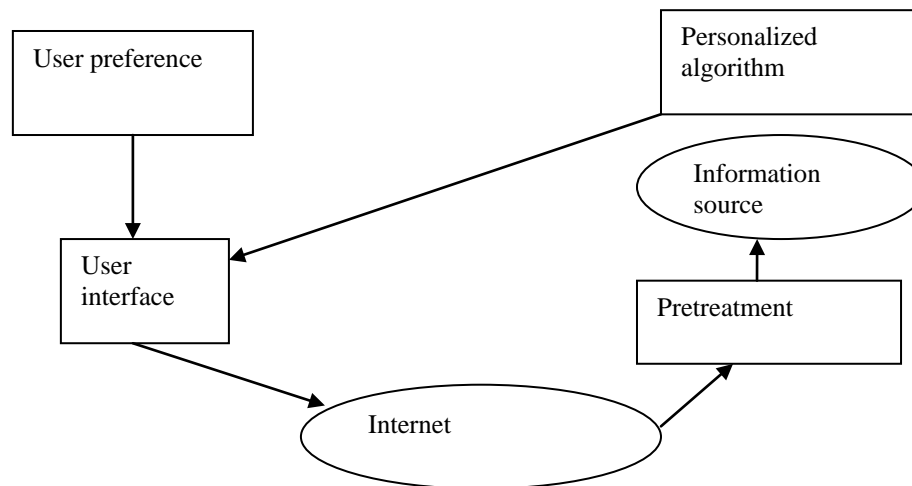


Figure 1 The personalized recommendation model

Content based systems are the use of resources and user interest similarity to filter the information, the user preference description and resource description preference using the same representation. The utility model has the advantages of simple and effective, the disadvantage is difficult to distinguish the resource quality and style, and not for the user to find new resources of interest.

Collaborative filtering system comparison is user preference description file, evaluation of a series of projects that the user as a vector, thus forming a matrix, by comparing the user describe the similarity degree between the vectors to form a similar user groups, and use of other users in the group to a higher evaluation of the project recommendation to the group is not on the project evaluation target user.

The advantages of collaborative filtering is to discover new information of interest to the user, the disadvantage is the existence of two difficult problem, one is sparse, both systems use early, because some system resources are not enough ratios, the system is very difficult to make use of fewer evaluations to find similar users, on the other one is the scalability of the system, with the increase of users and resources, the amount of computation will be more and more, so that the performance of the system will be more and more low.

### Filling the vacant using case-based reasoning

Recommendation system based on preferences of the user's personal information; take the initiative to recommend personalized service to the user of electronic commerce. Through the research on professional characteristics, intelligent user interest analysis, resource information may need to be recommended to the user, realize the personalized service of information. When the system load is small, the use of filtering algorithm based on improved case, the lack of the accuracy of recommendation information when the user evaluation, as shown in figure 2.

This paper introduces the case based reasoning technology, the composition of each user preference vector evaluation of some project as a case, case attributes set by the user evaluation of each item weight composition. Because of the similar user groups tend to assume a similar behavior, evaluation of fewer projects have many missing values, but some users to evaluate the, such as assuming that the user has to this project had evaluation, can be selected in the case of some attribute search and the user the target user evaluation of similar weight is the corresponding property.

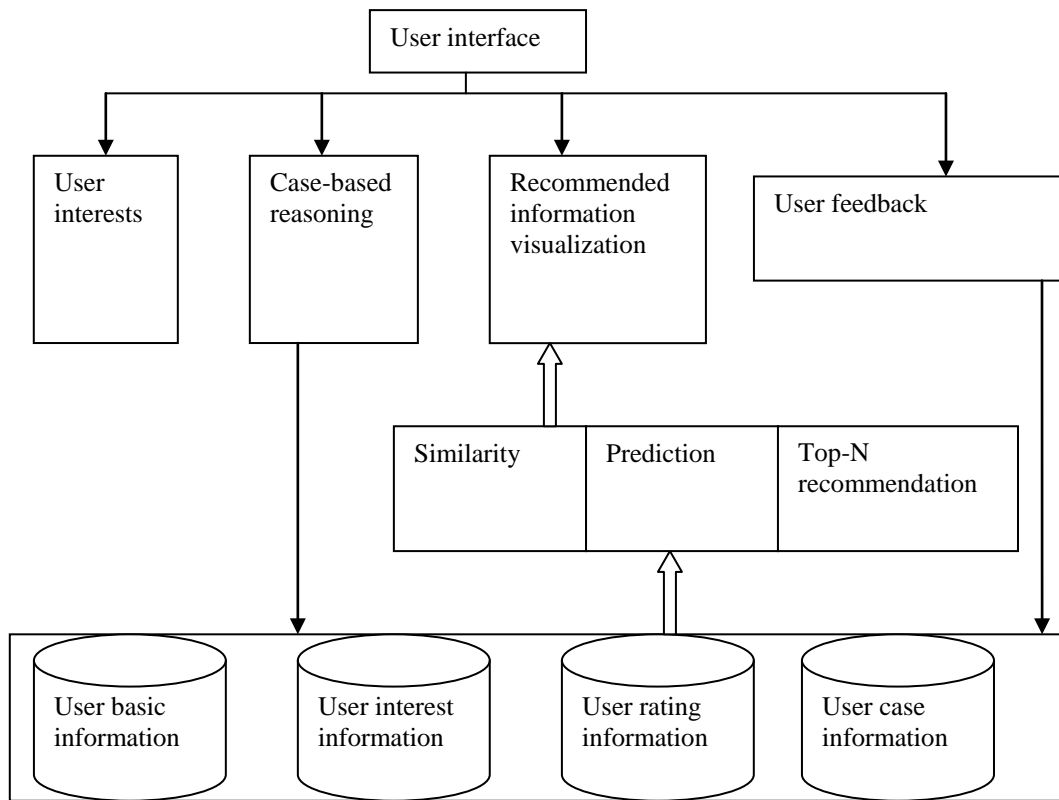


Figure 2 The personalized recommendation model

### Recommendation using collaborative filtering

Through empty user rating calculations using case based reasoning, obtained the complete user rating. And then, the collaborative filtering algorithm to generate a user rating prediction, we use based on user.

#### Measuring the similarity

There are several similarity algorithms that have been used in the collaborative filtering recommendation algorithm: Pearson correlation, cosine vector similarity, adjusted cosine vector similarity, mean-squared difference and Spearman correlation.

Pearson's correlation measures the linear correlation between two vectors of ratings.

$$zlp(i, j) = \frac{\sum_{c \in I_{ij}} (R_{ic} - A_i)(R_{jc} - A_j)}{\sqrt{\sum_{c \in I_{ij}} (R_{ic} - A_i)^2 \sum_{c \in I_{ij}} (R_{jc} - A_j)^2}}$$

The cosine measure looks at the angle between two vectors of ratings where a smaller angle is regarded as implying greater similarity.

$$zlp(i, j) = \frac{\sum_{k=1}^n R_{ik} R_{jk}}{\sqrt{\sum_{k=1}^n R_{ik}^2 \sum_{k=1}^n R_{jk}^2}}$$

The adjusted cosine is used in some collaborative filtering methods for similarity among users where the difference in each user's use of the rating scale is taken into account.

$$zlp(i, j) = \frac{\sum_{c \in I_{ij}} (R_{ic} - A_c)(R_{jc} - A_c)}{\sqrt{\sum_{c \in I_{ij}} (R_{ic} - A_c)^2 * \sum_{c \in I_{ij}} (R_{jc} - A_c)^2}}$$

#### Selecting the neighbors

Neighbors will serve as the recommended choice. Have adopted the recommendation system of two kinds of technology:

(a) threshold selection based on user, according to the similarity exceeds a certain threshold as the neighbors of the target user.

(b) the number of N-best neighbor Top-N technique in a predefined selection.

Producing the recommendation

Since we have got the membership of user, we can calculate the weighted average of neighbors' ratings, weighted by their similarity to the target user.

The rating of the target user  $u$  to the target item  $t$  is as following:

$$P_{uz} = A_u + \frac{\sum_{i=1}^c (R_{iz} - A_i) * \text{zlp}(u, i)}{\sum_{i=1}^c \text{zlp}(u, i)}$$

## Summary

Electronic commerce personalized recommender systems represent services that aim at predicting a customer's interest on information products available in the application domain, using customer s' ratings on products. Peoples' experiences often do not enough to deal with the vast amount of available information. Thus, methods to help find products of electronic commerce have attracted much attention from both researchers and vendors. In this paper, an electronic commerce personalized recommendation method using case-based reasoning is given. The method employs the case-based reasoning to fill the vacant and then uses collaborative filtering method to recommender.

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