

The Design and Implementation of Books Recommendation System

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Abstract- Personalized recommendation technology is a new technology which can mine products by using user's information, and that meet user's preferences through a series of algorithms, so as to achieve better recommendation effect. The number of books in university library is increasing rapidly. How to find interesting books from a large number of books is a problem that every reader is concerned about. In order to help these users find the books that they are interested in, this author designs a books recommendation system based on collaborative filtering algorithm. The system can basically meet the needs of users to recommend functions, and achieved good results.

Keywords- books recommendation system; data mining; personalized service

I. INTRODUCTION

With the rapid development of information digitization, networking and mobile technology, people's life has been surrounded by information technology. People have gradually stepped into the era of information overload. The form of knowledge bearing and the mode of transmission have undergone major changes. Recommendation system is an information filtering system proposed to reduce the additional cost of users in the search process [1]. The design of Recommendation system is mainly based on the concepts of association rules, content filtering and collaborative filtering [2-3]. According to the preferences of groups with the same hobbies and interests, users can recommend the information they are interested in. Through cooperative mechanism, users can respond to the information to a certain extent (such as rating, borrowing times) and record it to filter it, so as to help others choose the information. Collaborative filtering can be divided into group filtering and evaluation [4]. Personalized recommendation system is a high-level business intelligence platform based on massive data mining which to help the e-commerce websites provide fully personalized decision support and information services for shopping for the customers [5]. In this system, personalized recommendation technology based on collaborative filtering is used to recommend the books to users that they are most likely to be interested in through similarity calculation.

II. CURRENT STATUS OF RECOMMENDER SYSTEM

With the advent of the Internet, everyone can become a provider of content. These vast amounts of information have greatly exceeded the user's processing capacity, users need to spend a lot of time to find useful information for themselves. Therefore, how to help users quickly and accurately find the information they need has become an urgent problem for Internet information providers. At the same time, users also hope to get personalized services in the site. They hope that the site can understand the interests of users, so they can obtain information faster and accurate. Under this background, personalized recommendation technology arises at the historic moment. By using personalized recommendation technology, web site can effectively improve the quality and efficiency of service. For example, users can buy electronics, books, audio and video, clothing and other products on Amazon. When a user clicks on a product, the site makes recommendations in the form that the customer who buys the product also buys the product (as shown in Figure 1).

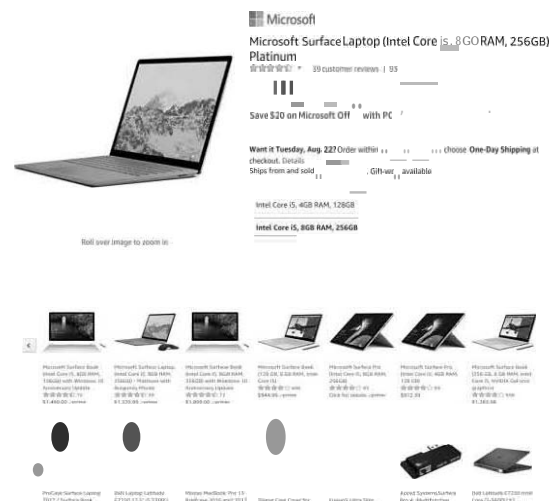


Figure 1. Example of personalized recommendation

Usually, a recommendation system establishes a user-based model or a project-based model by analyzing the user's behavior on the website, such as searching history, browsing

history, grading items, and metadata of the project. Then, according to the established model, the recommendation system pushes the resources that meet the user's interests to the user. At present, the main recommendation algorithms are content-based recommendation, collaborative filtering recommendation, Association rule-based recommendation and combination recommendation.

A. Content-based Recommendation

Content-based recommendation is the continuation and development of information filtering technology. It is based on the content information of the project to make recommendations. It does not need the user's evaluation of the project. In content-based recommendation systems, items or objects are defined by attributes of related features. Based on the characteristics of users' evaluation objects, the system learns users' interests and examines the matching degree between user data and the items to be predicted.

B. Collaborative Filtering Recommendation

Collaborative filtering recommendation technology is one of the earliest and most successful technologies in recommender systems. According to the user's preference for items or information, it finds the relevance of items or relevance of users, and then makes recommendations based on these relevance. There are two main categories: User-based collaborative filtering and Item-based collaborative filtering.

C. Association Rule-based Recommendation

Association Rule-based Recommendation is based on Association rules. It uses the goods that users purchased as rule headers and uses the rule bodies as recommendation objects. Association rule mining can find the correlation of different goods in the sales process, and it has been successfully applied in the retail industry.

D. Hybrid Recommendation

Because of the advantages and disadvantages of various recommendation methods, Hybrid Recommendation is often used in practice. Research and application are the combination of content recommendation and collaborative filtering recommendation. The simplest approach is to produce a recommendation prediction result using content-based method and collaborative filtering recommendation method respectively, and then combine the results with some method. Although there are many combinatorial methods in theory, they are not always effective in a specific problem. One of the most important principles of combinatorial recommendation is to avoid or compensate for the weaknesses of each recommendation technique after combination.

There are mainly weighting, switching, mixed, cascade and feature augmentation in combination methods.

III. PERSONALIZED BOOKS RECOMMENDATION SYSTEM DESIGN

In many universities, there are a large number of library resources with different kinds. The existence of a large number

of books of interdisciplinary, interdisciplinary and even new interdisciplinary and marginal disciplines makes it difficult for the model constructed by the content-based books recommendation system to fully and accurately characterize the content of book resources. So, the recommendation quality of content-based books recommendation system is relatively low. And it is difficult to meet the personalized needs of university teachers and students for recommendation resources. The higher borrowing frequency, the similar knowledge structure and the common knowledge background of the readers in University Libraries lead to the existence of a large number of borrowing records with high similarity. To provide high-quality personalized books recommendation services for college readers, collaborative filtering algorithm is used to carry out personalized books recommendation and meet the needs of data mining personalized information including the potential interests of readers. The structure of personalized books recommendation system is shown in Figure 2.

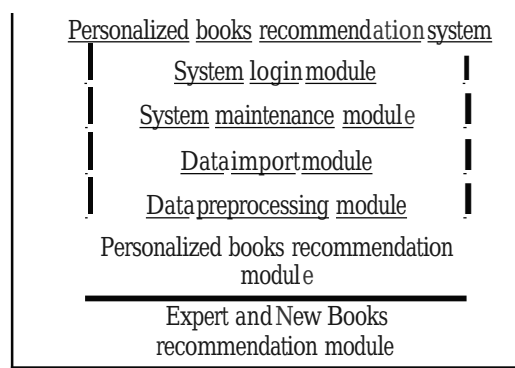


Figure 2. Sstructure of personalized books recommendati on system

A. Recommendation module design

Personalized recommendation module produces a list of books' recommendations to the readers based on the interest of library readers. Users' interest points are calculated by user borrowing history information through collaborative filtering algorithm.

This recommendation system only provides recommendation services to registered users. Usually, if the system does not get the personal information provided by users, users will not be able to obtain the best information service. When browsing the system, users can record their browsing records directly into the database. Registered users will get the result of recommendation list generated by the system after logging in.

Relying on a large number of books information, user information, borrowing books information in the library, the user CF and Item CF algorithm are combined to complete the personalized recommendation update.

The data export module is used to import user borrowing information and books information stored in the books database into the system memory in a fixed format, and the data processing is no longer dependent on the existing server. The books classification module is used to preprocess all kinds of borrowing data and user data, and classifies the borrowing

information according to the categories in the library. The books recommendation module recommends specific books to the readers according to the readers' interest points. The recommendation system module reads the information of the borrowed books from the books database and generates the recommended books to the borrowing users.

B. Expert and New Books recommendation

As mentioned earlier, there are problems in collaborative filtering recommendation based on reader/book, such as not being able to recommend books to new readers and not being able to recommend new books to readers. There is also a problem of "cold start" in the system, that is, when there is no reader-borrowing record at the beginning, it is impossible to recommend books for readers. In order to solve the above problems, the system integrates non personalized recommendation technology.

This system realizes the module of expert and new books recommendation. Experts can recommend classical books, and best-selling books. The new books recommendation module can recommend excellent new books to readers.

C. Database design

The database includes the tables of reader information, book information, borrowing record, reader similarity table, and book similarity and so on. Among them, the reader information table includes the borrower's name, password, loan card number and other information. The book information table includes all the information of a book, including price, book type, author, publication time, etc. The user borrowing information table saves the information of the book borrowed and returned by the user, including reader id, book id, borrowing time, book return time, etc. Reader similarity table and book similarity calculate the similarity between readers and books in order to recommend books to readers.

The main table structure is shown in Figure 3.

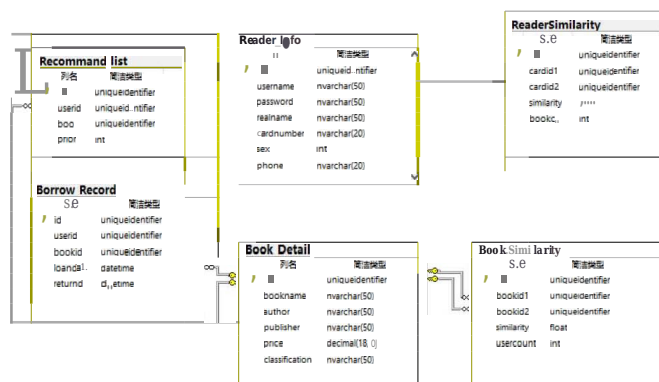


Figure 3. Sstructure of personalized books recommendation system

IV. INTERFACE DESIGN AND IMPLEMENTATION

A. Similarity and recommended list calculation

The system mainly uses collaborative filtering algorithm to realize books recommendation. There are two kinds of

collaborative filtering algorithms: user-based collaborative filtering and item-based collaborative filtering. The two methods are slightly different.

1) User CF

The user-based collaborative filtering algorithm consists of two steps:

a) Finding a collection of books similar to the interest of the target user.

b) Find books that the user in this collection likes and that the target user has not heard of, and recommend them to the target user.

The key to first step is to calculate the similarity of interest among two users. Here, collaborative filtering algorithm mainly uses the similarity of behavior to calculate the similarity of interest. Given user u and user v , let $N(u)$ denote that user u has a collection of books borrowed, and let $N(v)$ denote that user v has a collection of books borrowed. Cosine similarity calculation equation is shown in (1).

$$W_{uv} = \frac{|N(u) \cap N(v)|}{\sqrt{|N(u)| |N(v)|}} \quad (1)$$

After getting the similarity of interests between users, User CF algorithm will recommend the books that the users like the most similar to his interests. The following equation (2) measures the degree of interest of user u in User CF algorithm to book i :

$$P_{ui} = \sum_{v \in S(u, K) \cap N(i)} W_{uv} r_{vi} \quad (2)$$

Among them, $S(u, K)$ contains K users who are closest to user u 's interest, $N(i)$ is a set of users who have borrowed book i , W_{uv} is the similarity of user u 's and user v 's interest, and r_{vi} represents the interestingness of user v that in book i . Because it uses implicit feedback data of a single behavior, so all r_{vi} equal 1.

2) Item CF

The collaborative filtering algorithm based on item can be divided into two steps.

a) calculate the similarity between items .

b) generate recommendation list for users based on similarity of items and user's historical behavior.

The similarity of books is calculated by equation (3).

$$W_{ij} = \frac{|N(i) \cap N(j)|}{\sqrt{|N(i)| |N(j)|}} \quad (3)$$

In the formula, $N(i)$ is the number of users who have borrowed book i , while the molecule $|N(i) \cap N(j)|$ is the number of users who have borrowed book i and Book j at the same time.

After getting the similarity of books, we calculate the interest of user u to book j by equation (4).

$$P_{uj} = \sum_{i \in N(u) \cap N(j, K)} W_{ji} r_{ui} \quad (4)$$

The following C# code implements the above Item CF recommendation algorithm:

```
public Dictionary<string, double> Recommend(string user,
Dictionary<string, Dictionary<string, int> train,
Dictionary<string, Dictionary<string, double> W)
```

```
{Dictionary<string, double> rank = new Dictionary<string,
double>f);
```

```
Dictionary<string, int> action_item =train [user];
```

```
foreach (KeyValuePair<string, int> kv in action_item)
```

```
{ string item = kv.Key;
```

```
int score = kv.Value;
```

```
Dictionary<string, double> temp
```

```
W[item].OrderByDescending(o => o.Value).ToDictionary(p
=> p.Key, o => o.Value);
```

```
int count = 0;
```

```
foreach (KeyValuePair<string, double> tv in temp)
```

```
{
```

```
if (++count > K) break;
```

```
stringj = tv.Key;
```

```
double wj = tv.Value;
```

```
if (actionjtemContainsKey(j)) continue;
```

```
if (rank.ContainsKey(j))
```

```
{ rank[j] +=wj; }
```

```
else {rank.Add(j, wj);} } }
```

```
return rank.}
```

B. System implementation

The system is implemented by ASP.NET 2015 and SQL Server 2012. After the ordinary user has successfully logged in, they can click the recommended engine in the navigation bar to jump to the personal recommendation system page. New users can get the recommended books through the expert recommendation page, or can browse the latest books through the new book recommendation page. In the borrowing history page the readers can view personal borrowing records. The personal recommendation page is shown in Figure 4, and the borrowing history page is shown in Figure 5.



Figure 4. personal recommendation page

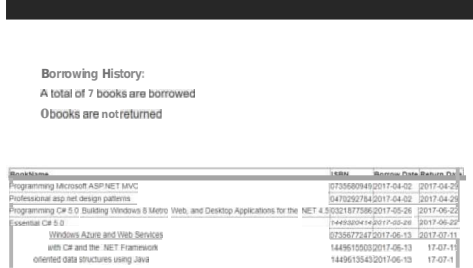


Figure 5. borrowing history page

V. CONCLUSION

This paper constructs a personalized book recommendation system based on collaborative filtering algorithm, and uses the expert recommendation function to recommend books for new readers and to recommend new books to readers, which is helpful to improve the utilization rate of books and the quality of information service, and realize the unification of personalization and accuracy of University Books recommendation.

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