



PBR: A Personalized Book Resource Recommendation System

Yajie Zhu, Feng Xiong, Qing Xie^(✉), Lin Li, and Yongjian Liu

School of Computer Science and Technology, Wuhan University of Technology,
Wuhan 430070, China

{zyjwhcn,xfeng,felixxq,cathylilin}@whut.edu.cn, liuyj626@163.com

Abstract. Recommendation system is widely applied for online resource retrieval, especially in digital publishing industry. A good recommendation system can help the users to efficiently find the desirable reading materials from the massive online resources. However, the conventional recommendation systems are always facing the cold-start problem, and it is difficult to provide the personalized service in an efficient way, since the users' preference may change sometimes. To address the problems above, this work introduces a personalized book resource recommendation system, which well utilizes the tag information of book resources to interact with the users. The user feedback will deliver their real-time preference, and the system can provide more precise recommendation candidates to improve the service quality. In this demo, we will introduce the overall framework and some important modules of the recommendation system, with relevant technical details. We will show the system functions by providing the visual results of the actual book resource recommendation.

Keywords: Recommendation system · Interactive recommendation
Tag association analysis · Cold start

1 Introduction

Digital publishing is a fast growing industry nowadays. Providing the various digital book resources available, and the large number of online customers, it is important to meet the customers' reading need from the massive book resources, and deliver the personalized knowledge service. Therefore, it is necessary to design a good recommendation system for users to retrieve their desired reading materials, so as to improve the users' reading experience and guarantee the system magnetism to the users. Generally speaking, the recommendation system needs to provide precise and personalized service. However, it is difficult to provide knowledge services to users when they are new to the system, because

This work is partially supported by Natural Science Foundation of China (Grant No. 61602353), National Social Science Foundation of China (Grant No. 15BGL048), and Natural Science Foundation of Hubei Province (Grant No. 2017CFB505).

the system has little knowledge about the characteristics of the new users and cannot recognize their reading preference, i.e., the cold start problem [2]. In addition, the accuracy of the traditional recommendation algorithm will be reduced if the users changed their interest greatly, so the system needs to keep high adaptiveness and adjusts the recommendation dynamically.

Considering the problems above, we propose to design an interactive book recommendation system named PBR, which can deal with cold start issue and meet the user's real-time reading demand. In this work, the most significant feature of the recommendation system is the tag-based user interaction, through which we are able to explore the user's preference by his feedback in keyword selection, and adjust the recommendation candidates dynamically.

There are some challenges in this recommendation system to achieve the expectant performance. The first issue is how to recommend book resources to the new users. We propose to primely analyze the new user by his basic information, and the recommendation candidates can be initialized following a decision tree based approach. When the new user accesses the system, his basic information will match a path in the decision tree and the initial recommendation candidates can be generated. The second issue is how to guarantee the efficiency of the system. We propose to optimize the tag interaction by entropy analysis. The tag set of book resources is analyzed by exploring the probability of tag occurrence. When the system interacts with users by tag information, the recommendation candidates will be dynamically reduced, and the recommendation list can be updated accordingly.

2 System Description

The PBR system is designed to extend an existing digital publishing platform RAYS¹, by which all the book, book tag and user information can be collected. Figure 1 shows the general framework of PBR system, which is divided into three parts. The first part is the analysis module, which mainly analyzes the tag distribution, the user and resource characteristics. The second part is the interaction module [3], which interacts with the users by providing various tag keywords, and refines the recommendation candidates according to users' tag selection. The third part is the recommendation module that applies collaborative filtering [1] algorithm to generate the final recommendation list for users to browse. Then we will introduce the relevant technical details of each module.

Analysis Module. The analysis module includes functions of user analysis, book resource analysis and tag distribution analysis. The user analysis runs to obtain the users' characteristics based on the book tag vector weighted by the users' historical behaviors on the book resources. The role of the resource analysis is to generate the feature vectors of the resources based on the assigned tag information, and the similarity between different resources can be estimated. The tag distribution analysis aims to analyze the tag occurrence probability

¹ <http://dcrays.cn/>.

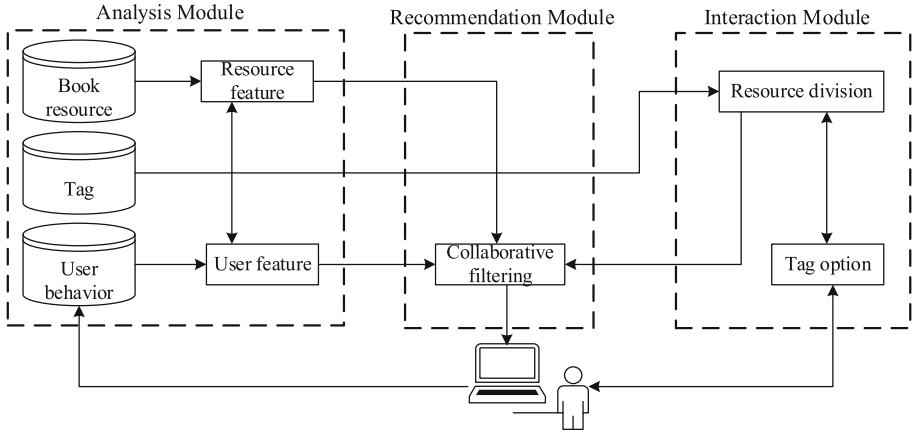


Fig. 1. System overview.

of different tags based on the resource-tag matrix. Given the categorized tags of the RAYS platform, the entropy values of different tag categories can be estimated, i.e., the information to be deliver by each tag category, which will be further utilized for quick identification of the desirable resource in the Interaction Module.

Recommendation Module. The PBR system adopts the tag-based collaborative filtering algorithm. For existing users, we are able to get the user and resource characteristics from Analysis Module. Based on the user feature, the system can find out the similar users and provide the resource recommendation following collaborative filtering. If the user is unsatisfied with the recommendation, the system will interact with the user to refine the recommendation results, which will be further explained in Interaction Module. For any new user, the system will deal with the cold start problem by proposing an initial recommendation list. Primely, the system analyzes the existing user information, and constructs a decision tree using the users' age, gender, reading location and reading time, and the output will be the user's theme tag. When a new user enters the system, once he provides some basic information, the matched path in the decision tree will suggest a set of book resources of certain subject (theme tag).

Interaction Module. The Interaction Module is the most important part, which aims to reduce the resource candidate set according to the user interaction, so as to improve the recommendation efficiency. During the recommendation procedure, The PBR system will first provide an initial recommendation list suggested by Recommendation Module. If the users are not satisfied with the recommended resources, the system will provide tag options to interact with the users. The tag options are determined according to the entropy results of Analysis Module. When the user selects certain tag words, the range of recommendation candidates can be reduced, and the system will generate a reordered recommendation list from the updated candidates. Such interaction will continue

until the user stops the interaction. Meanwhile, the process of interaction can also improve the user’s tag feature model by real-time updating.

Through the analysis of user, tag and resource, the system is able to recommend book resources to different users, and achieve the personalized knowledge service. At the same time, it considers the cold start problem and user interest transfer. The tag information is effectively used to interact with the users, so as to achieve precise and personalized knowledge service.

3 Demonstration

In the demonstration part, we will show the functions of the proposed book resource recommendation system PBR. We will display the user information in the analysis module, where the user’s characteristics can be generated according to the historical behaviors in the system. In addition, the resource recommendation module is mainly displayed. From a user entering the system, PBR will determine whether it is a new user, and initialize the recommendation list. The user interaction process will be exemplified, together with the recommendation list updating after interaction.



Fig. 2. Demonstration of the system workflow.

First we analyze the users’ characteristics, as shown in Fig. 2(a). The users’ operation behavior in the system will be collected to build the users’ tag features. The system will recommend the book resources for the users through a tag-based collaborative filtering algorithm. Figure 2(b) shows the initial book resources recommended to a user after entering the system. If the user is not satisfied with the recommended resources, the tag interaction is carried out by the interaction module shown in Fig. 2(c). The system then reduces the resource candidates according to the user’s tag choice, and reorders the resource recommendation list. The Fig. 2(d) shows the recommended book resources after user interaction.

References

1. Sarwar, B.M., Karypis, G., Konstan, J.A., Riedl, J.: Item-based collaborative filtering recommendation algorithms. In: The 10th International Conference on World Wide Web, pp. 285–295 (2001)
2. Shi, L., Zhao, W.X., Shen, Y.D.: Local representative-based matrix factorization for cold-start recommendation. *ACM Trans. Inf. Syst.* **36**, 22:1–22:28 (2017)
3. Xie, Q., Xiong, F., Han, T., Liu, Y., Li, L., Bao, Z.: Interactive resource recommendation algorithm based on tag information. *World Wide Web - Internet Web Inf. Syst.* 1–19 (2018). <https://doi.org/10.1007/s11280-018-0532-y>