Accurate Recommendation Algorithm of International Chinese Education Resources Based on Knowledge Map

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Abstract. In order to accurately recommend international Chinese education resources, an accurate recommendation algorithm for international Chinese education resources based on Knowledge graph is proposed. With international Chinese education resources as the core, a knowledge map based on the RDF triplet form of organization and the relationship between storage resources and resources has been constructed. In combination with the diversified attribute characteristics of education resources, two relationships have been set, namely, "concept attribute attribute value", "resource A-relationship resource B", according to knowledge extraction, knowledge representation. On this basis, based on the word frequency and inverse text frequency of user target resource keywords in the international Chinese education resource knowledge map, accurate recommendation of international Chinese education resources is achieved. The test results show that the recommendation time of the designed algorithm is only 10.4 s, and the f1 value is stable above 0.90. The recommendation performance is not affected by the size of the basic test data, and can effectively improve the accuracy and real-time performance of international Chinese education resource recommendations.

Keywords: Knowledge map; International Chinese language education; Resources recommendation; User target resource keywords; Word frequency; Inverse text frequency;

1 Introduction

On the basis of giving users more choices, massive educational data also puzzles users[1-2] to a certain extent due to information overload caused by the impact of information scale. To analyze the trend of large-scale development of educational information based on the goal of educational information pushers, and to tap the personalized needs of users is one of the core issues to be solved urgently to achieve service quality optimization[3-4]. In view of this, some scholars have proposed a collaborative filtering based accurate recommendation algorithm for educational resources, which has greatly improved users' satisfaction with the recommendation results. In addition, the accurate recommendation algorithm of educational resources

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based on data mining technology is also one of the more common technical means. This method shows obvious instability in the recommendation accuracy, which is difficult to adjust adaptively and timely in combination with the dynamic development of user behavior. However, in the face of the increasingly large scale of educational information, the corresponding time cost has gradually increased, and in the face of the efficiency requirements of users, it has some shortcomings[5-6]. On this basis, this paper takes international Chinese education resources as the research object, takes knowledge map as the core technology, proposes a precise recommendation algorithm for international Chinese education resources based on knowledge map, and uses comparative testing to analyze and verify the recommendation effect of the design algorithm.

2 Design of precise recommendation algorithm for international Chinese education resources

2.1 Construction of knowledge map of international Chinese education resources

Knowledge graph is a graphical Knowledge representation and reasoning method for organizing, representing and reasoning knowledge. The Knowledge graph has the ability of dynamic updating, which can be continuously updated and iterated with the generation and development of new knowledge to ensure the accuracy and timeliness of international Chinese language education resources. In order to ensure that the accuracy of the recommendation results of international Chinese language education resources can reach a high level, and at the same time minimize the time cost of the recommendation results, this paper first constructs a knowledge map[7-8] with international Chinese language education resources as the core. This paper uses the RDF triplet to organize and store resources and the relationship between resources as the main component of the knowledge map triplet of international Chinese education resources can be expressed as:

$$G = \{E,\ R,\ S\} \tag{1}$$

Among them, E represent the data set of international Chinese education resources in the knowledge map, R represent the relationship and attribute set between international Chinese education resources in the knowledge map, S represents all triples in the knowledge base of international Chinese education resources. Considering that the composition of international Chinese education resources has diversified attribute characteristics[9-10], this paper sets two relationship types: "concept attribute attribute value" and "resource A-relationship resource B". According to the above method, the specific implementation method of constructing the knowledge map of international Chinese education resources is shown in Figure 1.

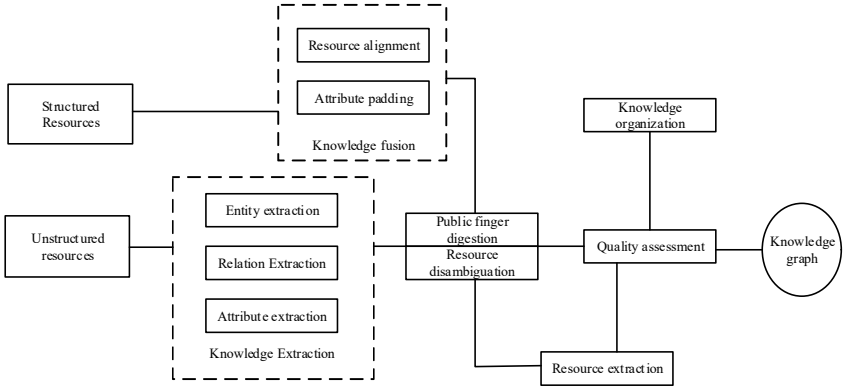

Fig. 1. Construction method of knowledge map of international Chinese education resources

According to the construction method of international Chinese education resource knowledge map shown in Figure 1, the specific implementation process is mainly divided into three parts, namely, international Chinese education resource knowledge extraction, international Chinese education resource knowledge representation, and international Chinese education resource knowledge storage. First, the knowledge entities of international Chinese education resources are extracted from the original database by means of knowledge extraction. The knowledge fusion technology is used again to fuse the extraction results with the third-party database. On this basis, the fused resources are stored in the data layer of the knowledge map in the form of triplets to achieve the construction of the knowledge map of international Chinese education resources.

2.2 Recommendation of international Chinese education resources

Combined with the knowledge map of international Chinese education resources constructed in section 1.1, in the specific resource recommendation process, this paper is mainly based on the word frequency and inverse text frequency of user target resource keywords in the corresponding resources of the knowledge map of international Chinese education resources. Among them, word frequency mainly refers to the frequency of user target resource keywords in the text of the knowledge map. In general, the number of users' target resource keywords in the text is positively correlated with the fit of users' needs, that is, the higher the word frequency, the higher the overlap with users' resource needs. For reverse text frequency, it mainly refers to the frequency of user target resource keywords in the overall knowledge map of international Chinese education resources. In general, the higher the frequency of inverse text, the higher the universality of corresponding international Chinese education resources. Among them, the word frequency calculation method of user target resource keywords in the corresponding resources of the international Chinese education resource knowledge map can be expressed as

$$TF = \frac{f_{i,j}}{\sum f_{k,j}} \tag{2}$$

Among them, TF indicates the word frequency of the user's target resource keyword i in the corresponding resource j of the international Chinese education resource knowledge map, $f_{i,j}$ indicates the number of times that the user's target resource keyword i appears in the corresponding resource j of the international Chinese education resource knowledge map, $f_{k,j}$ refers to the total number of phrases in the corresponding resource j of the knowledge map of international Chinese education resources.

The inverse text frequency calculation method of user target resource keywords in the corresponding resources of the international Chinese education resource knowledge map can be expressed as:

$$IDF = \lg \frac{|D|}{|1 + \{j : i \in j\}|} \tag{3}$$

Among them, IDF indicates the inverse text frequency of the user's target resource keyword i in the corresponding resource j of the international Chinese education resource knowledge map, D represents the total amount of resources in the knowledge map of international Chinese education resources, $\{j : i \in j\}$ refers to the total amount of resources including the user's target resource keyword i in the knowledge map of international Chinese education resources.

In the manner shown above $TF = TF_{\max}$, $IDF = IDF_{\max}$ as the final recommendation result, to ensure that the accuracy of the recommendation result can get a high level.

3 Application test

3.1 Test preparation

In the testing phase, this paper takes three public data sets in the education field as the basic number of tests, as shown in Table 1.

Table 1. Test Data Set Preparation

Test Dataset	Source	Constitute	Number of test questions	Number of knowledge points
FrcSub dataset	Integrate network data information	Basic Issues in International Chinese Education Content	1226	226

Math1 dataset	Data of International Chinese Education Final Joint Exam Questions in a School	Interaction data of student test questions and correlation matrix of test question knowledge points	1445	277
Math2 dataset	Data of International Chinese Education Final Joint Exam Questions in a School	Interaction data of student test questions and correlation matrix of test question knowledge points	1026	189

Based on the data information shown in Table 1, set 70% of the data as the training set, and use the educational resource recommendation algorithm designed in this paper, the collaborative filtering educational resource recommendation algorithm, and the data mining educational resource recommendation algorithm to carry out recommendation tests. For the analysis of test results, this paper takes F1 value as the evaluation index, and its calculation method can be expressed as:

$$F1 = \frac{2 * precision * recall}{precision + recall} \tag{4}$$

Among them, $precision$ indicates the accuracy of educational resource recommendation results, $recall$ indicates the recall rate of educational resource recommendation results. According to the above method, the accuracy of different algorithm recommendation effects is analyzed by using F1 value. It can be seen from Formula (1) that the larger the F1 value, the higher the accuracy of the corresponding recommendation results.

3.2 Test results and analysis

On the basis of the above, the test results of three different recommendation algorithms under different test data scales are counted, and the data information obtained is shown in Table 2.

Table 2. Statistical Table of Test Results of Different Methods

Proportion of test data scale/%	Collaborative filtering educational resource recommendation algorithm	Data mining education resource recommendation algorithm	Design education resource recommendation algorithm
30	0.9124	0.8506	0.9034
40	0.8519	0.8477	0.9149
50	0.8489	0.8456	0.9069
60	0.8192	0.8421	0.9232
70	0.7997	0.8423	0.9158
80	0.7855	0.8455	0.9141

According to the test results shown in Table 2, in the test results of collaborative filtering educational resource recommendation algorithm, the recommendation effect is significantly affected by the size of basic test data. When the test data size is 80% of the overall data set, the F1 value corresponding to the recommendation result is only

0.7855. In the test results of data mining educational resource recommendation algorithm, the recommendation effect under different basic test data scales shows obvious stability, but the overall recommendation result accuracy is relatively low, and the F1 value is basically stable below 0.85. In contrast, in the test results of the educational resource recommendation algorithm designed in this paper, the recommendation effect is not affected by the scale of basic test data, and the F1 value is always stable above 0.90, at a high level. Comparing the test results of three different recommendation algorithms, we can draw the conclusion that the precise recommendation algorithm of international Chinese education resources based on knowledge map designed in this paper can achieve accurate recommendation of education resources.

On this basis, further validate the real-time recommendation performance of the design education resource recommendation algorithm, using recommendation time as an evaluation indicator. The smaller the value, the higher the real-time recommendation performance of the method. By comparing the Collaborative filtering educational resource recommendation algorithm, the Data mining education resource recommendation algorithm, and the design education resource recommendation algorithm, the recommended time for different methods was obtained, as shown in Table 3.

Table 3. Recommended time for different methods

International Chinese Education Resources/MB	Collaborative filtering educational resource recommendation algorithm/s	Collaborative filtering educational resource recommendation algorithm/s	Design education resource recommendation algorithm/s
100	3.2	5.4	2.5
200	5.9	7.9	4.3
300	7.3	9.2	6.9
400	9.8	12.3	8.3
500	12.1	15.2	10.4

According to Table 3, as the amount of international Chinese language education resources increases, the recommended time for different methods also increases. When the amount of international Chinese education resources is 500MB, the recommended time for Collaborative filtering educational resource recommendation algorithm and Collaborative filtering educational resource recommendation algorithm is 12.1s and 15.2s, respectively, while the recommended time for the design education resource recommendation algorithm is only 10.4s. From this, it can be seen that the recommendation time of the design education resource recommendation algorithm is relatively small, indicating that the real-time recommendation of the design education resource recommendation algorithm is relatively high.

4 Conclusion

In order to effectively reduce the low utilization rate of educational resources caused by information overload and the difficulty in obtaining effective educational resources, this paper proposes an accurate recommendation algorithm for international Chinese

educational resources based on knowledge maps. Based on the characteristics of international Chinese educational resources, this paper constructs a knowledge map, and combines the actual needs of users to achieve accurate recommendation for educational resources. The application testing results show that the recommendation performance of the educational resource recommendation algorithm designed in this article is not affected by the size of the basic test data, and the f1 value remains stable above 0.90, and recommended time is only 10.4s. By comparing the test results of three different recommendation algorithms, it can be concluded that the educational resource recommendation algorithm designed in this article has a relatively high f1 value and high recommendation accuracy.

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