Design and Research of Mobile Learning Recommendation System Based on Deep Learning Perspective

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Abstract. With the advent of the era of big data, the amount of information shows an exponential explosive growth trend. At the same time, the personalized needs of users are increasing. Facing the massive data, how to help users quickly and accurately obtain the information they need is the main challenge facing them at present. With the rapid development of computer technology and communication technology, mobile teaching and deep learning have become new research hotspots in the field of education. Mobile education has become a very fashionable education mode, which not only brings modern people a more convenient education system, but also makes modern learners need not worry about learning time and content. Traditional recommendation methods generally have problems such as sparse data, cold start and difficulty in feature extraction. On the basis of expounding the concept, connotation and main characteristics of deep learning, this paper applies deep learning theory to mobile recommendation system, hoping to gradually improve and promote the existing mobile education and provide an effective learning way and method for learners.

Keywords: Big Data, Deep Learning, Mobile Education

1. Introduction

With the development of Internet in various fields, mankind has been brought into the era of rapid network economy, and internet plus has shown great advantages in its application in various fields. People have entered a brand-new digital information era, and due to the rapid iteration of Internet technology, the data scale has increased dramatically [1]. At the same time, with the popularization of the concept and technology of big data, both the traditional offline platform and today's online
application pay more and more attention to the collection of data, and the amount of data almost explodes exponentially [2]. With the rapid development of computer technology and communication technology, mobile teaching and deep learning have become new research hotspots in the field of education. The rapid development of information technology provides a large number of online services for Internet users. Users can access these project resources online at any time, but they also face severe information overload problem [2]. With the development of mobile communication technology, the popularity of smart devices and the promotion of mobile learning, it has become a reality for people to carry out and implement mobile education through mobile devices and mobile Internet. Mobile education has become a very fashionable education mode, which not only brings a more convenient education system to modern people, but also makes modern learners need not worry about learning time and content [4]. With the rapid development of information technology and the rapid popularization of the Internet in recent decades, information data has exploded and spread rapidly on the Internet, and more and more information and services are flooding the Internet [5].

For users, an accurate and efficient personalized recommendation system can help users quickly obtain their favorite articles, music and other information, save users' time costs, and the learning costs of various search engines, and improve user acquisition resources Efficiency and user experience [6]. Traditional recommendation methods generally have problems such as data sparseness, cold start and difficulty in feature extraction. Among the massive amounts of data information, the common content screening methods for content retrieval through search engines cannot perfectly solve the problem of data overload faced by users [7]. Therefore, it is of great significance to find a method that can help users reduce the burden of information filtering and actively help users find the information they want. Based on the concept and main features of deep learning, this article applies deep learning theory to the mobile recommendation system, in order to gradually improve and promote the existing mobile education, and provide learners with an effective learning method and Method, so that the learning efficiency and effect can be significantly improved.

2. Design principles of mobile learning recommendation system

In the early days, the recommendation system mainly had a joint filtering system, but with the rapid growth of machine learning in recent years, new recommendation schemes of machine and deep learning began to appear. Through the new system recommendation method of machine and deep learning, students' learning situation can also be dynamically analyzed, so as to generate the personalized recommendation needed by students in time. Compared with shallow learning, deep learning has obvious differences in memory mode, knowledge system, learning input, learning understanding and application of learning results [8]. Deep learning is a gradual process from shallow to deep. In this process, learners concentrate on the design of mobile learning recommendation system, and promote them to explore knowledge intentions as the goal, and guide them to learn high-level thinking. Deep learning requires learners to pay more attention to critical learning and reflection in real social situations and complex technological environments, and actively construct personal knowledge systems. Prediction and recommendation are two main problems solved by the classical recommendation system. Prediction problem means that the system needs to accurately predict users' preference for items, and recommendation problem refers to recommending the most likely favorite items to users according to the prediction results.
The process of personalized recommendation system for mobile learning is a circular process, which needs to be updated periodically. However, when the data in the data is transformed to a certain extent, it is necessary to update not only the database, but also the data warehouse and even the data model to improve the quasi-group degree of recommendation. The architecture of the recommendation system is shown in Figure 1.

![Mobile learning recommendation system architecture](image)

**Figure 1.** Mobile learning recommendation system architecture

A good recommendation system needs to use different recommendation strategies according to different scenarios and tasks, but these strategies are essentially common, that is, to discover the relationship between users and items according to user attributes or item attributes or interactive data between users and items or the collection of these data, and then to recommend items according to the possible results of this relationship. Learners can freely choose the way to complete their learning tasks, such as autonomous random learning and collaborative completion, which can produce interactive activities, realize the interaction between resource interfaces and contents, increase the communication and development among learners, and promote their interpersonal communication and expression ability. The recommendation system of mobile learning can analyze and judge the actual situation of students' learning through the operation mode when doing experiments, so as to make more accurate adjustments to the teaching plan [9]. The goal of recommendation system is to actively help users find personalized items they are interested in and recommend them to users. When learners are faced with many problems and learning tasks, inquiry learning is the best way to learn, which can help students master deep learning skills and apply them flexibly to learning, and then produce better learning results. The recommendation system of mobile learning can also analyze the atmosphere of class learning, thus providing students with a reasonable teaching environment, providing students with detailed and professional guidance, and finally making the teaching process accurate [10].

3. Design of mobile learning recommendation system based on deep learning theory

3.1. Resource module design

When designing the object model, we must pay attention to the following points. First, the model can realize quick response, so that users can form efficient interaction with the system. Secondly, the model can have the ability to work out different components, which can meet the different needs of users. Learners' learning time and space are random, which must be taken into account when developing and designing the mobile learning recommendation system. In the mobile learning
recommendation system, the users are mainly free learners, whose learning time is uncertain, and the learning place is also mobile. The learning tool is mainly based on mobile devices. At the same time, with the help of online learning platform, the integration of learning inside and outside the classroom and the sharing of learning resources can be achieved, so as to improve learning efficiency and promote deep learning [11]. Collect the attribute information data of articles, which is also called content attribute information data, and perform specific data processing and calculation operations on the attribute information data of each article, and the obtained result is the extracted content attribute features of articles. Through hierarchical design, we can ensure that the system has relatively clear operation logic. Although different levels are independent of each other, they can still cooperate properly. Learners learn actively and critically according to their own interests and hobbies in the learning process, which is accompanied by constant reflection [12]. When designing the page, we should not only have an excellent visual effect, but also comprehensively consider students' personality characteristics, actual preferences and behavioral habits, so that users can truly feel the convenience brought by the mobile learning recommendation system, so that students can keep a happy mood for learning. In some recommendation scenarios, it is sensitive to time, and the user's interest moves quickly, so the time factor can be increased when calculating the preference score.

Recommendation is mainly used to predict the interest of target users in items that have not been rated in the nearest neighbor information. The prediction of user interest can be calculated as follows:

$$P_{u,i} = \overline{R}_u + \frac{\sum_{m=1}^{n}(R_{m,i} - \overline{R}_m) \times sim(u,m)}{\sum_{m=1}^{n} sim(u,m)}$$

(1)

Where $\overline{R}_u$ is the average score of user u on the resource, $R_{m,i}$ is the score of user m on item i, $\overline{R}_m$ is the average score of user m on resources, and $sim(u,m)$ is the similarity between users u and m.

The low degree of automation of recommendation is caused by the untimely man-machine interaction. The relationship between "forwarding or not" and "posting tool" in the distribution comparison about behavior data is shown in Figure 2.
For learners, the mobile learning system has certain randomness in both learning time and learning space. When designing learning materials, developers should consider that the devices used by learners are mobile, portable and small-capacity, so they should follow the principle of small modularity and diversity when designing. It is difficult to obtain data of user attributes, because many users are unwilling to disclose their information on the Internet, and information producers will face serious privacy problems if they collect these data at will. When learners register for mobile learning, the recommendation system can analyze the information filled in by students, and recommend the most suitable courses that can meet the needs of users according to the actual situation of users. Learners can also select courses or adjust the course plans.

3.2. Interactive module design

On the basis of voice, video, text and other modes, it provides learners with more convenient channels for problem discussion and information sharing through various design schemes, so that learners can realize online virtual cooperation through mobile learning recommendation system, complete learning tasks, and achieve the effect of improving academic performance and ability. By calling the background test question bank, according to the learning progress of mobile learners, the learners' uncertainty can be tested actively at any time, and the whole system can track and evaluate the learners' recent learning effect and knowledge mastery. In online social networks, the cost and difficulty of socializing between people are greatly reduced, and users can find users with the same or similar interest points according to their own interests. Supervise and perceive learners' learning environment, time, stage and requirements, and give them reasonable suggestions and tips, so that learners can better achieve deep learning and improve their level with the help of mobile learning recommendation system [13]. In order to enable learners to learn deeply, it is necessary to create a good learning atmosphere and a quiet and undisturbed learning environment, so that students can devote themselves to learning wholeheartedly. Among the current mainstream recommendation systems, neighborhood-based collaborative filtering recommendation algorithm is the most common, which generally includes two types, item-based collaborative filtering and user-based collaborative filtering. In social networks, to accurately recommend users, we should not only pay attention to and

![Figure 2. Relationship between "forwarding or not" and "posting tool" in behavior data](image-url)
analyze the relationship between users and the recommended items, but also pay attention to and analyze whether there are inextricable connections among users in the system. In the training process, the model optimizes the parameters of the model by minimizing the cross entropy loss between Label and the predicted value of the model in the training data.

3.3. Recommended module design

By calculating the similarity of user information and user interest through the database, it is convenient for the system to push the learning resources that different learners may be interested in, and provide more targeted learning suggestions and personalized recommendations. The core element of the recommendation system is data, which has a wide range of forms and sources, so it is necessary to extract features that have great influence on the recommendation system from these data. For example, when extracting the features of user behavior, we can extract the active and displayed behavior features of users, and also observe the implicit features of users. The recommendation module is tailor-made for learners, which can not only stimulate learners' interest and enthusiasm, but also promote them to achieve the effect of deep learning.

The database of the mobile learning system records the transaction data of each customer. Each transaction data records the products purchased by customers, and each product has a category attribute. Therefore, according to the data and the user's evaluation information, the user's preference for each product category can be calculated as follows:

$$PC_{u,j} = \frac{\sum_{i \in I_u} PL_{u,i} \times \mu_j(x_i)}{\sum_{i \in I_u} \mu_j(x_i)} \quad j = 1, 2, 3 \ldots$$  (2)

In the formula: $PC_{u,j}$ represents user u's preference value for category, $PL_{u,i}$ represents user u's rating value for product i, $I_u$ represents the product set evaluated by user u, and $\mu_j(x_i)$ represents product i's membership degree to category j.

The length of recommendation list has a great influence on the average precision rate of multi-users. If the value is too small, the feasibility of the recommendation method cannot be explained. Excessive value will make the result difficult to predict. Figure 3 shows the relationship between recommendation list length and precision.
In the development process of recommendation system, an idea that has gradually become a consensus is that a recommendation system needs a high degree of agreement between data and algorithm in order to fully mine the information in the data and give full play to the specific advantages of a specific algorithm. In the social network, we can know the social attributes related to the current user according to the characteristics of the user, and all these characteristics can be added and mixed according to the needs, which will provide a more substantial data source for the recommendation system. Users' personalized needs are different in different contexts. Only by fully integrating context information into the mobile recommendation system can mobile recommendation results be generated better.

4. Conclusion

With the advent of the 5G era, higher requirements are put forward for Internet technology. As one of the important fields, recommendation system has been deeply applied to all aspects of the Internet. It helps people give solutions from massive information retrieval, and makes the original passive search mode become active. In the mobile learning recommendation system, learners focus on free and independent learning, with uncertain time and space and random equipment. They only use the network platform to realize the integration of learning inside and outside the classroom and share resources, so as to achieve the effect of deep learning. The mobile learning recommendation system based on deep learning mainly studies students' behavior habits and personality characteristics in the learning process through big data analysis and intelligent processing, and makes personalized recommendations according to the intelligent learning guidance function in the system. The mobile learning recommendation system can effectively generate mobile recommendations only after fully and accurately extracting and predicting the preferences of mobile learning users for various types of mobile learning content in the mobile network environment. In the process of designing the system, the designer must consider the accuracy of its information and the influence of deep learning. Only by integrating all factors can we design an effective mobile learning recommendation system, provide a
better and more effective learning platform for learners, and promote the further improvement and development of mobile learning education.

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