Research on Resource Personalization Recommendation Algorithm and Model Based on Computer Deep Learning

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Abstract. In the big data environment, the network learning environment has the problems of "information overload" and "information trek". In the online learning process, if we can obtain an intelligent, targeted, and personalized learning resource recommendation service, the learning efficiency and learning experience will be greatly improved. Personalized learning resource recommendation technology has gradually become an important research topic in the field of education and intelligent information processing. This paper mainly combines deep learning and recommendation algorithms to design a framework to improve the accuracy of recommendation results.

Keywords: Deep Learning, Personalization, Recommendation Algorithm

1. Introduction

Nowadays, deep learning algorithms have a very important significance in artificial intelligence related applications. It greatly improves the performance of original algorithms. Combining deep learning with recommendation algorithms has also become a research hotspot in recent years. The application areas of deep learning in recommendation systems include building features, generating recommendation candidate sets, and predicting recommendation scores [1].

2. Research background and significance

The recommendation system is not unfamiliar to us, and it has penetrated into all aspects of our lives, such as iQiyi’s movie recommendations, NetEase Cloud’s music recommendations, Taobao’s product recommendations, Meituan’s restaurant recommendations, Douyin’s short video recommendations, etc. Wait. Recommendation systems are everywhere.

Deep learning has been fully applied to appropriate fields (such as text, image, speech recognition, intelligent customer service, etc.), and remarkable results have been achieved. Because deep learning can solve many complex tasks in academia and industry while providing the most advanced results, academia and industry have been applying deep learning to a wider range of scenarios. At present, the popularity of deep learning is still unabated and is on the rise. Therefore, the use of deep learning in recommendation systems is a trend and a direction [2,3].
Using deep learning for recommendation systems, this field is indeed full of innovations. The recommendation system based on deep learning saves the trouble of manually extracting features, and the recommendation effect is better than traditional methods. The neural network in deep learning can change the selection and combination of activation functions and approximate the continuous function in any way. Based on this property, the neural network can handle complex interactions and accurately express user preferences.

3. Research status at home and abroad

With the development of interconnection, electronic equipment is becoming more and more popular, the amount of online data is also increasing, and people's choices on the Internet are also increasing. Recommendation systems have emerged, and the emergence of recommendation systems can help people make choices. In order to meet people's needs, the development of recommendation systems has also experienced the evolution from traditional recommendation algorithms to recommendation algorithms based on deep learning.

4. Brief description of recommendation algorithm and deep learning algorithm

Mainstream recommendation algorithms include: knowledge-based recommendation, content-based recommendation, collaborative filtering algorithm, and combined recommendation. See Table 1 for comparison of their respective advantages and disadvantages. The main models of deep learning are neural network, convolutional neural network automatic encoder, etc. This article focuses on the use of several related algorithms, the characteristics of which are briefly described below. Recommendation algorithms based on collaborative filtering can be divided into two categories, memory-based and model-based collaborative filtering [4]. Memory-based collaborative filtering is subdivided into user-based and item-based collaborative filtering. The former is suitable for systems where the number of users is much smaller than the number of projects, and the latter is suitable for systems where the number of projects is much smaller than the number of users. For example, in the news recommendation system, news categories (items) are only divided into a limited number of categories, such as finance, military, sports, etc., which are suitable for item-based collaborative filtering. For the whole, the calculation of the first category is too large. In the second category, a training model is designed for the data in advance, and user and project data are hidden. In the low-dimensional structure model, every calculation is performed based on the model, which improves the accuracy of the algorithm, the speed of calculation and the scalability of the system [5].

Table 1. The advantages and disadvantages of each recommendation algorithm

| Algorithm                        | The main idea                                                                 | Advantage                                                                                           | Disadvantage                                                      |
|----------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Collaborative filtering          | Analyze user feedback on historical items (ratings, comments, etc.), and recommend items changed by neighbor users with similar preferences | Wide range of applications, no need for professional knowledge, can recommend complex data, high degree of automation, the recommendation effect increases with the increase of users | Cold start, data sparseness, poor scalability, relying on large amounts of historical data |
| Recommend based on content       | Analyze user information and project information characteristics, and recommend projects or similar projects recently contacted by users | Intuitive, easy to understand, easy to accept, applicable text, web page data recommendation, avoid cold start and data sparse problems | Cannot cross domains, difficult to recommend abstract projects (movies, music), etc., and difficult to extract resource features effectively |
| Hybrid recommendation algorithm  | Combine multiple recommendation algorithms. One algorithm can be the main one and the other algorithms can be supplemented, or the result of one algorithm can be used as the input of another algorithm | Advantages of multiple algorithms                                                                    | Algorithm design is relatively complicated                       |
The recommendation algorithm is essentially machine learning. Deep learning is also a type of machine learning. Deep learning originated from artificial neural networks, simulating the mechanism of the human brain to interpret data. It combines low-level features to form a more abstract high-level representation to discover distributed feature representations of data. Deep learning performs multi-level representation and extraction learning to understand the meaning of image, sound and other data, learning layer by layer, each layer extracts one or more features of the data in different directions, and the knowledge (features) learned at each layer. As the input of the next layer, the number of learning layers is the depth of learning [6].

Convolutional neural network CNN has two basic structures, one is a feature extraction layer, and the other is a feature mapping layer, which can implicitly perform parallel learning from training data. Recurrent Neural Network RNN is an artificial neural network in which nodes are directionally connected into a ring. There are both internal feedback connections and feedforward connections between the processing units, which can display dynamic timing behaviors and have stronger dynamic behavior and computing capabilities than feedforward neural networks.

5. Combining research trends of deep learning and recommendation systems
The recommendation algorithm is the core of the personalized resource recommendation service technology, which largely determines the performance of the recommendation service.

The discussion of the problem of combining deep learning and recommender systems began in 2013 with the restricted Boltzmann machine-based collaborative filtering algorithm (RBM-CF) by K. Georgiev et al. In 2015, S. Sedhain et al. proposed a collaborative filtering recommendation model (AutoRec algorithm) based on an automatic encoder that performed well in experiments. A new recommendation framework is used in the two, but more information is more difficult to integrate, and the scalability is weak.

In view of the ability to analyze multimedia resources, many scholars have proposed some content-based recommendation algorithms to improve the traditional matrix factorization model's weak expressive ability. The experimental results are good and the recommendation effect is improved [7]. For example, FuZheng Zhang et al. used the CKE algorithm unsupervised autoencoder and convolution autoencoder to extract features of various information, and analyzed the structured information text and pictures of the recommended objects in multiple dimensions. Oord Aaron et al. used a deep convolutional neural network model to analyze the voice information of music (DeepMusic algorithm); WangHao et al. used an automatic encoder to analyze the text information in the resource (CDL algorithm).

In the product recommendation system, Wayn et al. established a connection bridge between e-commerce websites and social networking sites, and mapped user characteristics on the social network to the features in the product recommendation of the e-commerce website. Use RNN and user data on the e-commerce network to train Characterization of users and products. In the research of recommended videos by Covington et al., DNN is used to learn and represent the user's video viewing history and keyword search records, and the user's personal information is also input into the DNN to learn the user's potential feature vector representation [8].

In the enterprise-level recommendation system application, the music platform Spotify uses recurrent neural networks to predict user behavior, uses deep learning to analyze song styles, and recommends based on music styles; Netflix and Google have successfully applied deep neural network RNN to its video recommendation system; and Microsoft applied deep learning to the recommendation of applications and news, and achieved good results [9].

6. Personalized resource recommendation algorithm for learning resources based on deep learning
In the personalized recommendation service of learning resources, the characteristics of learners and learning resources are: learning resources are generally stored on the online course learning platform, and learners on the platform generally have more detailed personal information and learning purposes.
Learners visit learning Resources are often related to the learner's own attributes, such as professional career goals. However, when learners visit learning resources, they may not be their favorite, but may be only related to their own majors. There will be mutual relevance between learning resources, the knowledge content of the resources has a certain degree of continuity, and the content of the next learning may be dependent on the resources visited last time. That is to say, the order of access to learning resources should also be the range that the recommendation algorithm should consider, that is, the time factor of the change of learner's interest should be considered. However, the current collaborative filtering methods seldom take into account learners' interest trends over time. Recurrent neural network algorithm RNN has been proven effective for sequence models [10].

Through the analysis of the characteristics of the appeal, this article combines the neural network algorithm to improve the model-based collaborative filtering recommendation algorithm that additionally considers learner information, learning resource sequence information, and the time factor of learner interest change. The recommendation framework is shown in Figure 1.

![Figure 1. Collaborative filtering recommendation framework combined with deep learning](image)

The data processing flow of the framework is roughly as follows: extract the learner's attribute characteristics, including user ID resource D, learner major, learning resource category, resource subcategory, etc. as the input of the model; the first neural network CNN is based on the target learner and other The learner's similarity generates a recommended list of learning resources with the highest similarity as a candidate list; together with the characteristics of the sequence sequence of the learner's access to the learning resources, it is used as the input of the second neural network RNN, and the final output is consistent with the next short-term event theme. Top n recommended resources for learners.

7. Conclusion

This paper focuses on the framework of combining deep learning and recommendation algorithms to improve the prediction accuracy for learners of short-term recommendation systems. Although this method has effectively solved some problems in the research, there are still problems that exist or will exist in the future that need to be studied and resolved.

References
[1] Liang Tingting, Li Liqin. Design of Personalized Resource Recommendation Algorithm and Model Based on Deep Learning [J]. Intelligent Computer and Applications, 2018: 114-116.
[2] Long Hu, Li Na. Research on Personalized Learning Resource Recommendation System Based on Deep Learning [J]. Computer Programming Skills and Maintenance, 2020: 128-130.
[3] Tan Mingxin, Bao Xiaoyin. Research on Personalized Recommendation of Generative Learning Resources Based on User Model [J]. Software Guide, 2017: 127-131+135.
[4] Wei Wenjie, Fu Yubo. Research on Recommendation Algorithm of Personalized Learning Resources [J]. China Educational Informatization, 2018: 91-96.
[5] Wang Junshu, Zhang Guoming, Hu Bin. Review of recommender algorithms based on deep learning [J]. Journal of Nanjing Normal University (Engineering & Technology Edition), 2018: 39-49.
[6] Guo Qing-ju, Zhou Rang-ming, Ma Jun-tao. Research on Personalized Recommendation
[7] Zeng Xuyu, Yang Yan, Wang Shuying, He Taijun, Chen Jianbo. A Hybrid Recommendation Algorithm Based on Deep Learning [J]. Computer Science, 2019: 133-137.

[8] Liu Zhongyu, Gao Yuhan, Hu Chao. Design of personalized learning model based on deep learning [J]. China Educational Informatization, 2016: 88-92.

[9] Zeng Xuyu, Yang Yan, Wang Shuying, He Taijun, Chen Jianbo. A Hybrid Recommendation Algorithm Based on Deep Learning [J]. Computer Science, 2019: 133-137.

[10] Liang Tingting, Li Liqin. A brief analysis of personalized recommendation algorithm and platform design of learning resources [J]. Education Modernization, 2018: 177-180.