ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202203_5(3).0051

Research on Recommendation System Based on Deep Learning

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Abstract

In the field of machine learning, deep learning is an important research direction. As the most advanced machine learning technology, deep learning has been applied to various complex recommendation systems to improve its quality. This paper analyzes some applications of deep learning in recommender systems, and looks forward to the future development trend of deep learning in recommender systems.

Keywords

Deep learning; Recommendation system; Neural network.

1. Introduction

As the internet has found its way into people's everyday life, Data is developing faster and faster. It has been difficult to single out items that meet the interests of users through a simple search. In order to improve the user experience, the recommendation system came into being. The recommendation system can accurately locate users' interests, recommend the products they are most interested in, and provide more complete personalized recommendations, so the scope of application of the recommendation system continues to expand. The essence of the recommendation system is to dig out the user's preference characteristics from the messy data. The problem of information overload can be solved by recommender systems. It has been extensively studied and applied in academia, and certain results have been achieved. With the rapid development of deep learning technology, The combination of deep learning technology and recommendation system has become a current research hotspot. Based on this, this article briefly analyzes the research on the recommendation system based on deep learning, and explores the impact of the development of deep learning on personalized recommendation.

2. Traditional Recommendation Algorithms

Traditional recommendation algorithms are usually divided into three types.The most commonly used collaborative filtering recommendation algorithm is mainly to discover the preferences of group users by mining the historical behavior and data of different user groups, and then divide users based on different preferences, and recommend similar products for users with the same preferences. Content-based recommendations are mainly based on items that users have selected or rated, and similar items are mined in other content as recommendations. Hybrid recommendation is implemented by fusing different recommendation algorithms to avoid the limitations of a single method.Traditional recommendation algorithms generally have many problems. The collaborative filtering recommendation method relies heavily on historical item scoring data, and it often encounters the problem of sparse scoring data in practical applications, which affects the recommendation effect. Data sparseness can lead to cold start problems. In the content-based recommendation system, the content can be used to recommend new items, but this method has difficulties in feature extraction. Traditional recommendation algorithms have been able to achieve better recommendation results, but some problems often occur.

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3. Introduction to Deep Learning

Deep learning is an algorithm for learning data representation in machine learning. Deep learning can learn automatically, and learn the deep features of the data through a large amount of training data, thereby improving the accuracy of data classification or result prediction. Deep learning has strong learning ability, wide coverage, and can solve most complex problems. At present, deep learning has achieved excellent results in the fields of automatic speech recognition [1,2], image recognition [3,4,5] and natural language processing [6,7,8].

Deep learning algorithms can be divided into two types. The supervised learning models mainly include multilayer perceptron(MLP),convolutional neural networks(CNN) and recurrent neural networks(RNN) etc. [9]. Unsupervised learning models include restricted Boltzmann machine(RBM), sparse coding, auto encoders, denoising autoencoder, and deep belief networks (DBN) etc. [9].

4. Recommendation System Based on Deep Learning

The use of deep learning technology for recommendation systems usually takes the historical data of the system as input, uses deep learning technology to learn the deep expression of historical data, and then recommends. According to the current studies, the current research is mainly divided into 5 directions:

4.1. Recommendation Based on Self-encoder

The autoencoder is an unsupervised model that attempts to reconstruct the input data in the output layer. The recommendation system of commonly used autoencoders is mainly to discover the potential characteristics of users, and when users make rating predictions, enter the rating part, learn from the autoencoder to get the deep expression of the data, and then use this group of expressions to get the predicted value, and finally make recommendations. Sedhain et al. [10] proposed a method of collaborative filtering based on self-encoders. In this method, the input part of the model is a row or column in the scoring matrix, and the output is generated through an encoding process and a decoding process, and finally by minimizing repetition The structural error optimizes the parameters in the model. Strub et al. [11] used two stacked denoising autoencoders, and took the user and item score vectors as the input of the model, respectively, and obtained the implicit representations of the data, and finally predicted the missing scores through the implicit representation .

4.2. Recommendation Based on Convolutional Neural Network

In the model of the convolutional neural network model, the convolutional layer mainly implements convolution operations on input data and outputs feature maps. The pooling layer realizes the dimensionality reduction of the feature map and reduces the processing time. Usually use max pooling or average pooling operation. Finally, the output of the pooling layer is used as the input of the fully connected layer to achieve classification. At present, convolutional neural networks have been applied to image and object recognition, audio processing, etc. Convolutional neural networks are often used as feature extraction tools in recommendation systems and are widely used for feature extraction in items such as text and music. Seo et al. [12] proposed an attention-based convolutional neural network model, which uses comment information to make recommendations. The model includes a user network and an item network. Convolutional neural networks are used to learn the deep features in the data. And the attention mechanism is used to model the relevance of different parts and features in the comments.KIM et al. used the model to learn hidden features in project review documents, and proposed a convolution matrix factorization model for better recommendation [13].

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4.3. Recommendation Based on Recurrent Neural Network

Unlike ordinary neural networks, recurrent neural networks also have connections between hidden layers. The cyclic neural network has the function of memory, so the cyclic neural network is particularly suitable for modeling sequence data. At present, recurrent neural networks have been used to machine translation and speech recognition. In current studies, recurrent neural networks are often used to model user behavior sequences, or combine attention mechanisms to construct text information sequences, which are used in scoring prediction, text recommendation and other fields. Wu et al. [14] used recurrent neural networks to model users' time series behaviors. In the study, they distinguished different types of explicit feedback and implicit feedback data, and combined a cyclic part and an acyclic part to recommend users. Wu et al. [15] used cyclic neural networks to model the evolution of characteristics, and proposed a cyclic recommendation network that can predict the future behavior trajectory of users.

4.4. Recommendations Based on Restricted Boltzmann Machines

The restricted Boltzmann machine is essentially a codec. It is a neural network model that has been used very early, and is generally composed of a visible layer and a hidden layer. Currently in the recommendation system, it is mainly combined with the system filtering method and used to predict user ratings. Feature extraction and feature detection are carried out through deep learning models. Inspired by the above, a new model is formed by combining multi-layer Bozeman machines with traditional methods. By extracting the features of the original data, it is combined with the traditional nearest neighbor method for scoring prediction. Recommend users. Georgiev et al. [16] extended the restricted Boltzmann machine model by increasing the association between users, the model can simplify the computational complexity.

4.5. Recommendations Based on Deep Belief Networks

deep belief networks can be regarded as a superposition of multiple restricted Boltzmann machines, the hidden layer of each restricted Boltzmann machine subnet serves as the visible layer of the restricted Boltzmann machine in the next subnet. Each restricted Boltzmann machine uses the contrast divergence algorithm for training, which makes the training of the deep belief network simple and effective. Because the deep belief network has obvious advantages in one-dimensional data modeling, it is currently mainly used for music recommendation in the recommendation system. Wang et al. combined the deep belief network and probability matrix decomposition, and learned the implicit representations of music and users through the model. Finally, the two implicit representations were predicted and scored, which effectively improved the effect of music recommendation [17].

5. Research Trends of Recommender Systems

With the development of technology,deep learning will receive more attention in recommendation systems. Use deep learning techniques for recommendation systems have become a hot topic of current research. However, it can be seen that the application of deep learning in recommendation systems is still in its infancy. There will be more extensive attempts in the future. Several possible research directions are summarized below.

5.1. Combine Deep Learning with Traditional Recommendation Methods

Traditional recommendation methods, including content-based methods and collaborative filtering methods, are difficult to effectively learn user and item information at a deep level. Using deep learning models to fuse a wide range of data, you can learn in-depth representations of users and items. The traditional recommended method has the advantages of simplicity and strong interpretability. Therefore, the combination of deep learning and traditional

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recommendation methods can integrate the advantages of the two methods. Although related research has appeared, this direction still deserves more attention from researchers.

5.2. Cross-domain Data Fusion Recommendation Based on Deep Learning

With the continuous improvement of data collection capabilities, users can obtain information in different fields. For example, users may have accounts on multiple platforms. The integration of user data on different platforms will overcome insufficient information in a single field, thereby alleviating the problems in the traditional studies. It is better to use data from multiple fields at the same time to discover user preferences.

6. Conclusion

The problem of information overload is caused by the development of the Internet. Traditional recommendation algorithms face many challenges in practical applications. Deep learning has the ability of automatic learning, and combined with traditional recommendation methods, it can effectively improve the quality of recommendations. At present, deep learning has some research results in the recommendation system, but overall it is still in its infancy, and its model needs further research in terms of scalability, complexity and interpretability.

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