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Deep Learning in E-commerce Retail

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Abstract: With the continuous development of the e-commerce economy, consumers have gradually stepped from the dilemma of lack of information to the dilemma of excess information. In addition, under the influence of the epidemic, this year has set off a wave of live broadcasts in e-commerce, making more and more many people join the industry. In order to solve the shortcomings of existing research in the field of e-commerce retail, this paper discusses the functional equations of deep neural networks, the deep learning Caffe framework and the characteristics of e-commerce retail, and aims at the sample data of deep learning in the field of e-commerce retail and parameter settings are briefly introduced. And the design of the deep learning neural network e-commerce retail product recommendation system is discussed. Finally, the product click-through rate (CTR), transaction rate and favorable rate in the application of the deep learning neural network e-commerce retail product recommendation system designed in this paper are used in Adaboost. , RNN model for experimental comparison. The experimental data show that the click-through rate (CTR), transaction rate and favorable rate of products in the deep learning neural network application designed in this paper reach an average of 93%, while the Adaboost and RNN models reach 83% and 87% respectively. Therefore, it is verified that the model designed in this paper has good training effect and practical value in the field of e-commerce retail.

1. Introduction

The e-commerce environment is increasingly complex, the needs of customers are increasingly diverse, the competition among e-commerce companies is increasingly fierce, and the challenges faced by e-commerce in the process of business decision-making are also increasing. The application of deep learning in e-commerce is very important for the development of e-commerce retail important.

Nowadays, more and more scholars pay attention to the research of various computer

technologies and system tools in the field of e-commerce retail, and through practical research, they have also achieved certain research results. Bharadwaj N proposed a deep learning-based item prediction method for recommending suitable items based on user preferences and sizes. The method proposed by Bharadwaj N can obtain different customer and preference data and can model the preferences or information behind a single user. The method optimizes a set of item parameters to collect relevant information from customers and items. Customer- and item-specific variables are utilized to obtain their parameters, resulting in personalized item recommendations [1]. Geetha P is one of the key links in the development and growth of e-commerce retail, regardless of the scale or channel of e-commerce retail sales. Geetha P aims to use a deep learning model to predict the number of customers in e-commerce retail, and through specific experiments from different perspectives, it correctly predicts the number of customer churn and analyzes the reasons for churn, which has an impact on the development of overall e-commerce retail performance. very effective. And it provides a reference model for the customer churn prediction method of e-commerce retail enterprises [2]. Nanqi Y E believes that the task of commodity recognition is the foundation of e-commerce development. It is also the key to the success of e-commerce enterprises, which can help buyers conveniently and correctly find the relevant product information and user information they are looking for. For e-commerce search engines, the brand and style of the product should be automatically identified from the user's shopping query, so that Quickly obtain user shopping preferences. Helps match the assortment of items to buyers' purchasing preferences. Nanqi Y E developed an end-to-end machine learning system to build an effective product information and user information identification system for e-commerce search, which requires no additional manual identification work [3]. Although the existing research in the field of e-commerce retail is very rich, the research on e-commerce retail with deep learning neural networks still has certain limitations.

Therefore, in order to enrich the existing deep learning neural network research in the field of e-commerce retail, this paper firstly discusses the functional equation of deep neural network and the concept of deep learning Caffe framework and the characteristics of e-commerce retail, and then discusses the deep learning neural network designed in this paper. In the field of e-commerce retail, the parameter settings and sample data of the product recommendation system are used. Finally, the model architecture of the product recommendation system of the deep learning neural network is designed, and the experimental test is carried out through the specific application of the designed model to the product recommendation system. Finally, Experiments show that the deep learning neural network designed in this paper is effective in the field of e-commerce retail.

2. Deep Learning in the Field of E-Commerce Retail

2.1. Deep Learning Caffe

Caffe is an open source deep learning framework, which mainly implements neural networks, and is the preferred deep learning tool for e-commerce retail commodity classification [4]. Has the following characteristics:

(1) Modularity: Caffe is set as modular as possible from the beginning, and can adjust and expand the multi-data format, loss function in the network layer, etc. [5].

(2) Separation of representation and implementation: Caffe's model definition is defined by the configuration file of the ProtocolBuffer language [6]. In any way with or without a chain graph, a function call is implemented to complete the conversion between CPU and GPU [7].

(3) Test coverage: In Caffe, each single e-commerce retail project corresponds to a test [8].

(4) Reference model: For e-commerce retail projects, Caffe provides some reference models [9]. However, the high-speed computing claimed by Caffe in the early design stage is simply to use GPU to accelerate computing [10].

2.2. Deep Neural Networks

Deep neural network forward propagation algorithm, the transfer process is as follows:

Assuming that $m-1$ and m are used to represent two moments in e-commerce retail commodities, then the input vector of a certain commodity information r in the hidden layer at moment m consists of two parts [11]. As shown in formula (1):

$$k_r^m = \sum_{u=1}^{U} f_{ur} y_u^m + \sum_{r=1}^{R} f_{r'r} c_r^{m-1} \tag{1}$$

In the above formula, k_r^m is the input information of commodity information r in m users; f_{ur} is the weight of input commodity information and user information, y_u^m is the input user information at time m, $f_{r'r}$ is the weight of commodity information and the previous commodity information; c_r^{m-1} It is the output of $m-1$ commodity information [12].

Then the mathematical calculation of m commodity information output variables is shown in formula (2):

$$g_r^m = \varpi_r(w_r^m) \tag{2}$$

In the above formula, g_r^m is the output variable of m commodity information; ϖ_r is the excitation function of commodity information [13].

At this time, the mathematical calculation of m user information input variables is shown in formula (3):

$$w_v^m = \sum_{r=1}^{R} f_{rv} g_r^m \tag{3}$$

In the above formula, w_v^m is the input variable of m user information; f_r^v is the weight of commodity information and user information. By analogy, the information transfer process of the entire network can be obtained [14].

2.3. E-Commerce Retail

E-commerce retail enterprises usually have the following characteristics:

(1) Technology-intensive features

E-commerce has got rid of the shackles of traditional labor-intensive enterprises, relying on advanced technology, combined with financial capital operation, making the retail business's operating mode a new look. The use of network technology breaks the previous time and space limitations [15].

(2) Wide range of transaction objects and low transaction costs

In e-commerce trade, there are few links in commodity circulation, and relatively few fixed assets need to be invested. Due to the few circulation links, e-commerce retail enterprises also reduce labor costs accordingly and greatly reduce transaction costs [16]. Expanded the scope of consumption, greatly increased the number of commodity sales [17].

(3) Fast update of network technology

Operational risks such as return risk and unsound laws, etc. E-commerce enterprises use network platform for transactions and electronic payment settlement, and the security and stability of

network technology is the core of management [18]. The advancement of network technology is also a key factor that all e-commerce businesses need to keep an eye on.

3. Investigation and Research on Deep Learning in the Field of E-Commerce Retail

3.1. Application of Deep Learning in the Field of E-Commerce Retail Research Data Processing

User data is the basis for the role of the product recommendation model in the e-commerce retail field. Before applying deep learning to design the product recommendation model in the e-commerce retail field, the collected data needs to be reconstructed and standardized into the corresponding format. The main purpose of data processing is to remove irrelevant data, select data attributes related to the topic, and randomly divide 70% of the data as the training set and 30% as the test set. The processed data are shown in Table 1:

Table 1. Partial data distribution

User Info	Product information	Time	Product rating	Whether to favorite
1001	01001	2022.4.5	Praise	Yes
1002	01002	2022.5.6	Average	Yes
1003	01003	2022.5.14	Average	Yes
1004	01004	2022.5.25	Praise	No
1005	01005	2022.6.12	Praise	Yes

3.2. Application Research and Training Environment of Deep Learning in The Field of E-Commerce Retail

The method used in this paper is to use GPU to design a complex deep learning product recommendation system through TensorFlow. This model will take a long time in the data preprocessing part, so 5 CPUs are selected during data preprocessing and pre-recommended product recommendation information at the same time. Deal with. Therefore, the environment used in the system test in this paper is shown in Table 2:

Table 2. Software and hardware environment for deep network training

System	Red Hat4.8.7-4
CPU	InelXeonE5-2697
main frequency	2.30GHz
GPU	GTX1080ti
Memory	11G
Python	3.6
CUDA	7.0
TensorFlow	GPU-1.4.0

4. Research on the Application of Deep Learning in Product Recommendation in the Field of E-Commerce Retail

4.1. Structural Design of Product Recommendation System in The Field of E-commerce Retail by Deep Learning

At this stage, deep learning has made great progress in other fields such as image processing and natural language processing. This paper proposes a recommendation system design for commodities

in the field of e-commerce retail through deep learning, and uses deep learning to represent massive user-related data. The architecture of the recommendation system based on deep learning is shown in Figure 1, in which the extraction of user interest features and item features are integrated in the same deep learning algorithm framework.

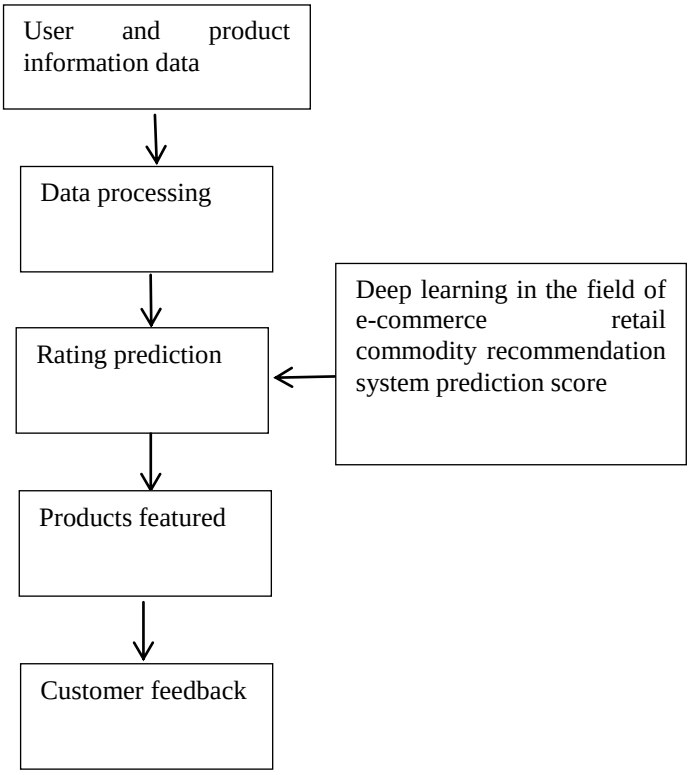

Figure 1. Deep learning in the field of e-commerce retail product recommendation system architecture

According to the previous demand analysis, the product recommendation system based on deep learning neural network is divided into four parts: user and product data input, user and product data processing, user and product data prediction and product recommendation output. The basic process of product recommendation is as follows:

(1) Using the TensorFlow framework, the recommendation model is obtained for the personalized recommendation of the product, and the relevant data is input into the recommendation model through the ID and other information of the user to be recommended for analysis and operation.

(2) The system performs scoring and prediction on the candidate products, and obtains the predicted score of each candidate product.

(3) Sort the candidate recommended products from large to small according to the scores, and take the top N as the recommended products.

(4) Call the information in the database, query the product name, price and other information according to the calculated product ID, and visualize the results.

4.2. Application of Deep Learning in Product Recommendation System in the Field of E-Commerce Retail

After completing the design of the deep learning neural network product recommendation system in the field of e-commerce retail, this paper tests the effectiveness of the system and uses the

data set collected in this paper for testing. Since the product click rate can represent the effectiveness of the model's product recommendation, the click-through rate (CTR), transaction rate and favorable rate of the e-commerce platform are selected as the test evaluation indicators. Three different models, Adaboost, RNN, and deep learning neural network (DNN), were deployed as the models of the hidden layer, and the parameters were kept unchanged from offline training. According to the user behavior timestamp information, the product clicks, transactions and praise data in the week of July 2022 are counted for testing. The test evaluation results are shown in Table 3.

Table 3. Evaluation results of click-through rate, transaction rate and favorable rate

Model	Adaboost	RNN	DNN
CTR	0.78	0.86	0.89
Transaction rate	0.82	0.89	0.92
Favorable rate	0.85	0.90	0.95

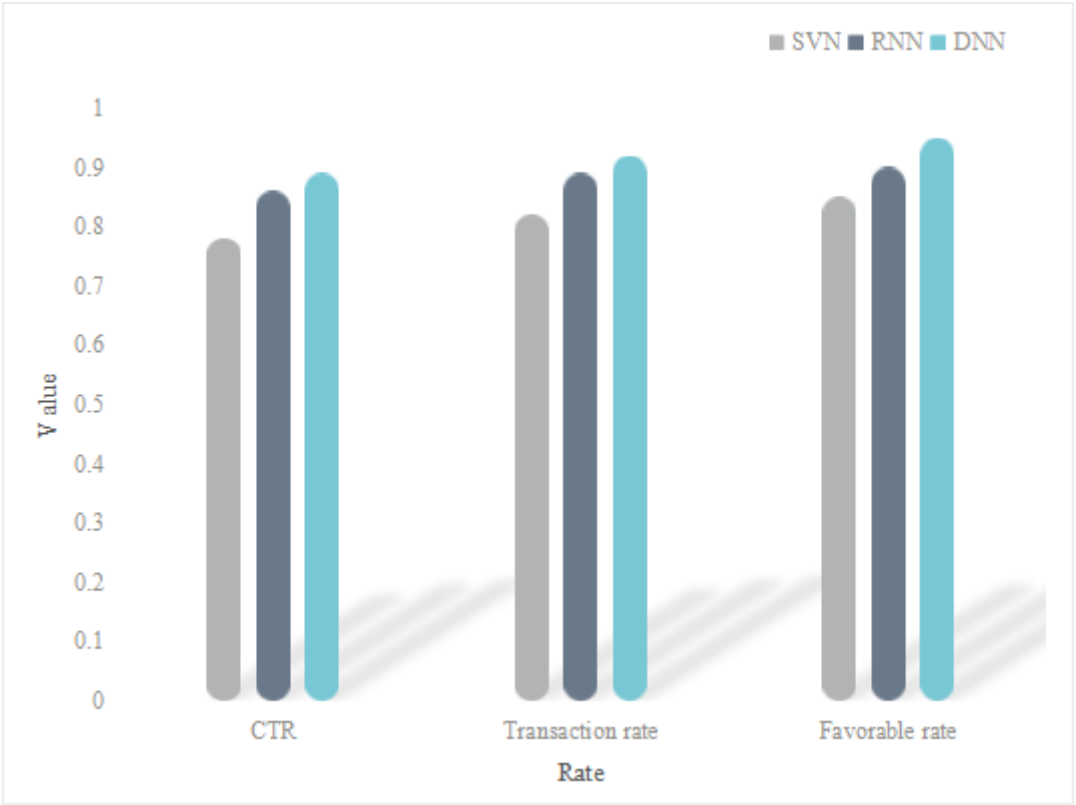

Figure 2. Comparison of evaluation results of click-through rate, transaction rate and favorable rate

From the data comparison in Figure 2, it can be seen that the three different Adaboost, RNN, and deep learning neural network (DNN) models show the performance of the click rate, transaction rate and favorable rate of products in one week. This paper proposes a deep learning neural network (DNN) in the evaluation of e-commerce retail products is generally better than the Adaboost and RNN models deployed in the hidden layer. Among the test data of e-commerce retail products, the deep learning neural network (DNN) model reaches 95%, The SVN and RNN models reached 85% and 90% respectively, while the deep learning neural network (DNN) model reached 89% in the

CTR transaction rate of e-commerce retail products, and the other two models reached 78% and 86% respectively. Among the e-commerce retail commodity transaction data, the deep learning neural network (DNN) model has reached 92%, while the Adaboost and RNN models have reached 82% and 89% respectively. Therefore, it is further verified that the deep learning neural network (DNN) model is used in electricity. Effectiveness of services in retail merchandise.

5. Conclusion

This paper specifically expounds the technical basis of deep learning neural network implementation in the field of e-commerce retail commodity recommendation system, including the functional equation of deep neural network and deep learning Caffe framework and the description of e-commerce retail characteristics, as well as the application of deep learning neural network in e-commerce The parameter setting and sample data deployment process of the commodity recommendation system in the retail field are designed, and the process framework of the commodity recommendation system in the e-commerce retail field is designed with emphasis on the deep learning neural network. The training effect of the product recommendation system designed by the deep learning neural network is compared with the Adaboost and RNN models, which proves the superiority of the deep learning neural network in the application of the e-commerce retail field.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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