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Computer network connection enhancement optimization algorithm based on convolutional neural network

Hanju Li
Sichuan University, Chengdu, 610225, China
sufhatqau189@163.com
Corresponding author

***Abstract*—Computer network topological structure is a kind of physical composition mode, which is composed of three aspects, namely, network computers or network equipment, nodes and lines in network transmission media. > This type of optimization problem is often solved when expanding the topology of a computer network. This paper establishes a reasonable network structure model based on the convolutional neural network to express the complex nonlinear relationship in the computer network connection, and proposes an optimization algorithm based on the characteristics of the computer network. I hope to provide some reference and reference for promoting the use of convolutional neural networks in computer networks.**

Keywords—Convolutional neural network algorithm, computer network topology, network characteristics

I. INTRODUCTION

The mode of computer network connection also refers to the computer network topology, which is the node formed between the computer and the network, as well as the formed line [1]. The nodes of the network are mainly composed of two types: the nodes that convert and exchange information, including some devices such as switches, hubs, and controllers; and the access nodes, including the computer host and interrupt. The line connected between the computer and the network is a variety of transmission media including tangible and intangible [2].

With the rapid development of computer network technology, the computer network topology is becoming more and more complex, so the expansion of its structure is more important. At present, it is more important to choose the right node and improve the capacity and efficiency of the network. The sub-problem is the problem of connection enhancement [3]. It is very important to add additional connections without adding additional nodes, and it is also a key to improving the cost-effectiveness of the network. In the current situation, there are not many ways to achieve computer network connection enhancement, but to maximize profits under the right connection, the best way is to optimize the network algorithm [4].

This article starts with the structure of the network and the topology of the network. For example, in the selection of network nodes, select appropriate and reasonable nodes, and then add these nodes to the running computer network. At the same time, it is necessary to ensure that the work of other nodes is not affected. It can achieve the purpose of improving the connection efficiency of the network and the network bandwidth capacity, and it also strengthens the interactivity of information, thereby expanding the topological structure of the computer network [5].

II. ALGORITHM PRINCIPLE OF CONVOLUTIONAL NEURAL NETWORK

The artificial neural network system is a pioneering work in the middle of the last century. It is widely used and has good parallel processing, distributed information storage, self-organizing and self-learning capabilities. Convolutional neural networks have been widely used in many fields, especially It is more concerned by researchers in the fields of information processing, pattern recognition, intelligent control, and system modeling [6]. The convolutional neural network algorithm is a supervised learning algorithm that uses learning samples to use backpropagation methods. The deviation of the network is adjusted repeatedly, so that the output structure and the expected vector are infinitely close [7].

The typical structure of convolutional neural network usually includes: input layer, convolution layer, down-sampling layer (also known as pooling layer), fully connected layer and output layer [8], as shown in Figure 1.

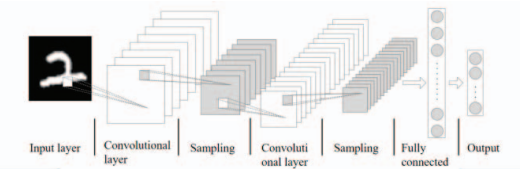

Fig.1 Typical structure of convolutional neural network

Due to the deep structure of the convolutional neural network, these features are conducted layer by layer through the layers of the network, so that the expression of the low-level simple features of the computer network connection to the high-level abstract features can be obtained, which has a stronger discrimination than the traditional artificial design features And generalization performance. However, due to the complexity and diversity of the computer vision field, there are still many problems that need to be solved urgently in the in-depth study of convolutional neural networks in specific fields [9]. For example, in the application of computer network connection classification to reduce the over-fitting problem of the network to improve the discriminative performance of the convolutional neural network; in the scene labeling application, the convolutional neural network is used to improve the accuracy of the labeling while improving the

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result of the scene labeling. Regional consistency [10].

III. Optimized computer network connection enhancement algorithm based on convolutional neural network

A. Network model construction

The structure of the network model determines the data fitting ability and generalization performance of the network model. In actual applications, the structure definition of the network model needs to define the depth of the network according to the amount of training data and the characteristics of the data set itself. , The hierarchical functions of the network, and the hyperparameters in the network. As a heuristic method, the standard of convolutional neural network structure definition mainly comes from some experience summaries. In the actual experiment process, it is usually necessary to debug the structure and hyperparameters of the network based on the training data set to obtain the best network performance [11].

The numerical characteristics of each network into the network model data set have different dimensions. The data of different dimensions will increase the training time of the convolutional neural network. Therefore, in order to speed up the convergence of the training convolutional neural network, this paper uses minimum-maximum normalization to linearly transform the original data, and map the data values to [0,1]. Assuming that the input numerical features remain unchanged, the formula is as shown in (1)

$$x_i = \frac{x_i - \min(X)}{\max(X) - \min(X)} \quad (1)$$

Among them, max(X) and min(X) are respectively expressed as the maximum value and the minimum value in the numerical xin feature. The forward conduction process of the network model is the expression process of the input data at various levels in the network. The forward conduction of the network is based on the training results of a specific training set. A new feature expression of the input image will be output at each level of the network. For the type-specific features of the network into the network model, this article will use one-hot encoding or dumb Variable coding is used for numerical operation. Assuming that the number of numerical features is n, the number of dimensions of categorical features after one-hot encoding or dummy variable encoding is n. Then the number of dimensions of the total combined feature N2, $N \in z$ is solved to satisfy the following constraints (2)(3):

$$(N-1)^2 - (n_m + n_c) < 0 \quad (2)$$

$$N^2 - (n_m + n_c) \geq 0 \quad (3)$$

The features of the last layer of the network are usually converted into the probability distribution output of the category through the full connection. In addition, the high-level feature expression of the convolutional neural network has strong discrimination and generalization performance, and can be used in the application of transfer learning [12]. Convolutional networks have the problem of gradient explosion or disappearance, which makes deep learning models difficult to train. In order to solve the above problems, this part will introduce short-circuit jump links, and its structure is shown in Figure 2.

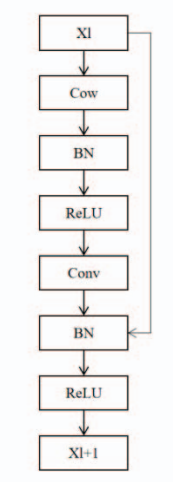

Fig.2 Short-circuit jump link structure diagram

Assuming that the computer network of the f-th layer of the neural network has undergone data preprocessing and data conversion, the feature map of the image is m, and then the features of the network convolutional neural network data are extracted through a layer of convolution operation. In order to prevent the gradient dispersion phenomenon generated by the neural network during the training process, this paper will batch normalize the output after the previous convolution operation, so that the mean and variance of the output result are 0 and 1, respectively.

B. Computer network model fusion based on convolutional neural network

The diversity of the network comes from the structural differences of each convolutional neural network. For the same input network model, each network will output a prediction based on the input. The predictions from multiple networks need to be fused in an appropriate way. The convolution network fusion model is shown in Figure 3.

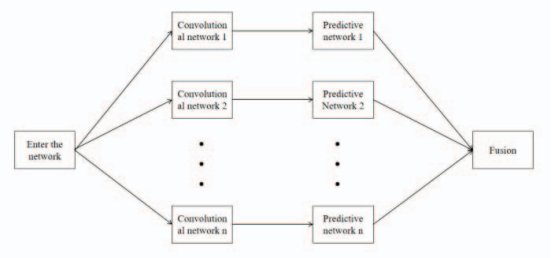

Fig.3 Convolutional network fusion model

Based on the convolution, our fusion model introduces the function of the mean of the random variable instead of the mean of the function of the random variable. As shown in formula (4)(5),

$$Si = \frac{1}{2}[1 + \tanh\left(\frac{Ui}{T}\right) \quad (4)$$

$$Ui = \sum WiSi + Ii = \sum Wi(Si) + Ii \quad (5)$$

Among them, (x) represents the mean value of the variable x. Substituting the mean field variable Vi for the random variable mean (Si), the computer network model convolution kernel has an impact on the model in two aspects. On the one hand, the size of the convolution kernel determines the scale of the network model, and also affects the size of the output feature network; on the other hand, the number of convolution kernels also affects the number of feature networks [13]. However, for a specific data set, there is currently no effective method to determine the optimal convolution kernel size and the number of feature networks.

Therefore, this chapter builds multi-column convolutional neural networks with different structures by setting different convolution kernel sizes and the number of feature networks, and trains each convolutional neural network model on the training set separately to achieve different network models The purpose of structure fitting training data set. Finally, by fusing the output results of each network, a relatively good prediction result is obtained.

C. Logistics connection optimization based on convolutional neural network

After the convolutional neural network model fusion, the convolutional neural network has excellent discrimination ability for the extraction of complex feature networks. Overfitting is a common problem in the field of machine learning. The main reason is that the learning model overfits the features of the training set, which leads to the lack of generalization performance of the model and affects the feature extraction and judgment of the test data set. . The input image after different preprocessing has a richer expression, which is helpful for the network to determine the final image category. Finally, the model's judgment of the object category is obtained based on the mean value of the multi-column neural network prediction. As shown in formula (6),

$$MCDNN_i = \frac{1}{N}\sum_{j=1}^{N} DNN_j \quad (6)$$

MCDNN represents the probability of the i-th category output by the multi-column convolutional neural network. DNN represents the number of convolutional neural networks; j represents the index of the j-th network in the multi-column convolutional neural network.

First of all, in the choice of network structure, the use of exactly the same convolutional neural network structure may limit the difference of the network for feature learning to a certain extent. The advantage of the multi-column network structure compared to the single-column network is that different networks can learn the characteristics of the input image from different angles. Then, increasing the difference between different networks through changes in the network structure is a potential method to improve the overall performance of the network.

Secondly, the method of connecting and enhancing the prediction of multi-column networks by simply taking the average value is relatively simple, because the discriminant performance of different networks is different [14]. Network prediction results with better performance. Therefore, it is necessary to consider a more flexible network connection enhancement mechanism.

This article uses pseudo-variable encoding for one of the features, and uses one-hot encoding for the other categorical features. After the preprocessing step, the number of feature dimensions has been expanded from 41 to 121. After that, we convert each data of the convolutional neural network with 121-dimensional features into a 1 1×1 1×1 array. The operation is shown in Figure 4.

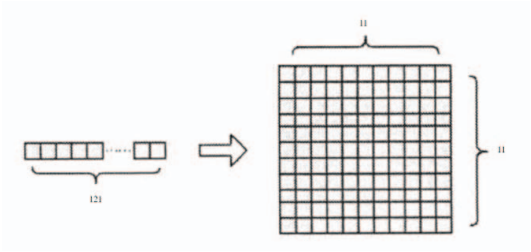

Fig.4 Data conversion operation

The main reason for this result is that convolutional neural networks are superior to machine learning methods in terms of feature extraction capabilities. The accuracy of traditional machine learning methods is lower than that based on convolutional neural networks. This is because the representation of normal and abnormal data after feature extraction is similar in terms of low-level features. However, convolutional neural networks can automatically extract complex high-level features from these similar low-level features.

For the multi-scale salient regions (Q1, Q2, Q3) extracted by the computer network, it is necessary to use the convolutional neural network trained on the large-scale network data set to extract the features U(K) respectively. These parameters are passed in the large-scale network The training on the data set changes from a random state to a stable convergence state. Finally, the characteristic expression of the multi-scale significant area of the entire computer network is obtained (7):

$$U = U(1) + U(2) + U(3) \quad (7)$$

The accuracy of computer network topology shows the proportion of all correctly labeled computer network topologies in the data set occupying the computer network topology of the entire data set. This evaluation method reflects the accuracy of scene labeling to a certain extent, but ignores an important feature of a data set, that is, the number of computer network topologies of each category label in the data set is not consistent [15]. This characteristic causes the evaluation method of computer network topology accuracy to be affected by the large number of computer network topology categories. Therefore, as a supplement to the evaluation method of computer network topology accuracy, the category average accuracy evaluation method has also been widely adopted. The category average accuracy evaluation method first obtains the computer network topology accuracy of each category itself, and then sums and averages the accuracy of each category to obtain the final scene labeling accuracy. The category average accuracy evaluation method ensures that the computer network

topology accuracy of each category has the same influence weight on the final scene labeling accuracy. This relevance means that under the existing convolutional neural network framework, by improving the characteristics of general convolutional neural networks, it is beneficial to further improve the accuracy of computer network topology results.

IV. Conclusion

This article is based on the research of convolutional neural network, mainly focusing on the key technology of computer network connection enhancement. Aiming at the problem of object recognition, this paper takes the characteristics of the network as the research of the structure of the convolutional neural network model as an entry point. By fusing multiple columns of convolutional neural networks with different structures, objects with better stability than a single network structure are obtained. Recognition effect. No matter which algorithm is adopted to simulate the network connection, it is necessary to evaluate its performance in the end. This paper selects the convolutional neural network algorithm. According to the analysis of the calculation process, it is concluded that the algorithm that can make the network connection achieve better results in the convolutional neural network algorithm is the average field neural network algorithm, because it is not only fast but also The result is closer to the real situation, so the algorithm is feasible in terms of enhancing and optimizing the computer network connection and expanding the topology of the network structure.

According to the current research situation, there are still many ways to enhance and optimize computer network connection efficiency and increase network communication capacity, but these methods and measures have more or less problems of this kind, or they are not practical. And the economy, and the enhanced and optimized computer network connection ground averaging neural network algorithm proposed in this paper can well meet the above requirements and has good economy [16].

By establishing a scientific and reasonable field average neural network model, it is helpful to carry out computer network connection enhancement and optimization in the field average neural network algorithm research work, and then judge the network effect. It should be noted that when using the function method to construct a model, we should strengthen the problem of constructing the objective function. Based on the enhanced optimization network connection average field neural network algorithm, in order to analyze this neural network algorithm in depth and achieve the desired result, the first step is to construct an excellent average field neural network model. The construction of the network algorithm model needs to pay attention to many factors, especially in the process of constructing and selecting the objective function to choose appropriate, scientific and effective. Based on the characteristics of computer networks, there are other different connection enhancement optimization algorithms, such as simulated annealing algorithms and genetic algorithms. This article only discusses the convolutional neural network algorithm alone. Compared with other algorithms, whether it is more feasible, this article does not do more in-depth research. This is also the future research direction of computer network connection enhancement optimization algorithm based on convolutional neural network.

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