Application of deep learning algorithms in the field of intelligent Chinese medicine

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Abstract: The realization of intelligence in Chinese medicine is an inevitable result of technological development. Thousands of years of experience in the development of Chinese medicine in our country have left us precious spiritual wealth. How to achieve further development with the help of deep learning algorithms in the context of big data is a subject worthy of study. Based on the background of big data, this paper analyzes the application of deep learning algorithms in the field of intelligent Chinese medicine.

1. Introduction

The new round of profound changes in science and technology and the industrial revolution has promoted profound changes in all areas of society. Artificial intelligence is an important achievement of this round of industrial revolution, and the country also regards artificial intelligence as an important component of China's industrial development. Traditional Chinese medicine is a treasure of the Chinese nation. A great deal of experience has been accumulated in the development process of 5,000 years. How to not only inherit the tradition well, but also absorb the advanced science and technology of the contemporary, carry forward the ancient medicine and innovate. The top priority. With the advent of the era of big data, relying on cloud computing's parallel processing capabilities for big data and deep learning algorithms, breakthroughs have been made in the field of artificial intelligence. With the help of this algorithm, you can put massive data into the algorithm, let the data speak for themselves, and the system will automatically learn and extract features from the data. The use of artificial intelligence and data mining technology to empower TCM research and application has positive practical significance for improving the intelligence of TCM.

2. Big data, deep learning algorithms, and TCM intelligence

2.1 Big data provides the foundation for intelligent TCM

The era of big data has arrived and has become the consensus of the world. The complicated information in the era of big data is more of an opportunity while it challenges people. The in-depth integration of traditional Chinese medicine and Internet big data is a national strategy and the focus of research in the field of traditional Chinese medicine. It is of great significance to further research and develop the big data industry of traditional Chinese medicine and enhance the international status of traditional Chinese medicine. "Internet + Traditional Chinese Medicine" has become a national strategy a few years ago. China's "Outline of Strategic Planning for the Development of Traditional Chinese Medicine 2016-2030" clearly proposes to promote "Internet +" Traditional Chinese Medicine, and has made specific and specific references to "Internet + '" Traditional Chinese Medicine. Comprehensive deployment. There are several aspects to the intelligent promotion of big data for the development of Chinese medicine. The first is the mining and use of TCM data. China's TCM is extensive and profound. It is a profound academic and clinical system. The development of Chinese medicine for thousands of years in China has accumulated a wealth of big data. It is a gold mine that needs to be developed and mined. The intelligentization of these rich data will have an unparalleled role in promoting the development of TCM. Secondly, big data is

combined with the core concepts of TCM to achieve the orderly development of TCM. How to use these data scientifically, reasonably and effectively for the research of clinical effects of the population has become the key to the leapfrog development of TCM.

2.2 Deep learning algorithms are intelligent tools of TCM

Computer deep learning algorithms are based on big data. It is a tool and method in the intelligentization of traditional Chinese medicine. The evaluation of clinical efficacy of traditional Chinese medicine is essentially a causal relationship analysis between TCM syndrome differentiation and clinical outcomes. The concept of big data can reflect the relationship and causality. Deep learning algorithms calculate this causality further. Traditional Chinese medicine is more a record of clinical processes, and unique clinical experience is formed in the accumulated experience and case analysis. Characterizing these experiences in the form of big data modeling will greatly realize the intelligence of traditional Chinese medicine. The development of TCM requires the support of a standard system. The point of fall should be to develop a standard system to promote shared applications, and then to realize the innovation and application of TCM big data in the field of Internet medical treatment, and to promote the big data of TCM in the world in a greater sense Development, which in turn promotes the internationalization of Chinese medicine. Big data-based computer deep learning algorithms provide conditions for the modernization and standardization of TCM development. With the further development of data mining algorithms, computer technology can be used to discuss the characteristics of its internal laws and its internal correlations. It saves time and effort than manual analysis, and combines the personal experience of experts. Summary of inherited experience is of great significance to the inheritance and development of Chinese medicine.

3. The basic principles of applying deep learning algorithms (neural networks) to the intelligentization of traditional Chinese medicine

3.1 Basic principles of neural networks

Artificial neural networks do not require precise mathematical models and no assumptions about variables. They can handle complex, uncertain, and non-linear problems by simulating human intelligent behavior. Artificial neuron model: Artificial neuron is the basic element of neural network, and its principle can be represented by the following figure. Among them, $x_1 \bigcup x_n$ is the input signal from other neurons, W_{ij} represents the connection weight from neuron j to neuron i, and θ represents a threshold, which is the intercept b. The relationship between the output and input of the neuron is expressed for:

$$net = \sum_{j=1}^{n} w_{ij} x_j - \theta, y_i = f(net_i).$$

Among them, y_i represents the output of the neuron, and function f is called the activation function. If X is used to represent the input vector and W is used to represent the weight vector, the output of the neuron can be expressed as a form of multiplication of the vectors: $net = XW$, $y_i = f(net_i) = f(WX)$, parameterizing the matrix, and using matrix-vector arithmetic, we can use the degree of linear algebra Neural network for fast solution.

In practical applications, non-linear activation functions are often used to introduce non-linear factors to make the data linearly separable after transformation, solving problems that cannot be solved by linear models. In further research, it is shown that the selection of the activation function has an important effect on the cluster analysis effect of the entire algorithm. How to choose the appropriate activation function is the key to the entire neural network modeling.

Due to the derivative function $f'(x) = \frac{ae^{-ax}}{(Le^{-ax})} = afx(-f)x$ of the non-linear function $Sigmoidf(x) = \frac{1}{1+e^{-ax}} (0 < f(x) < 1)$. However, this artificial neural network only has feedback signals

during the training process, and the data can only be transmitted forward during the classification process until it reaches the output layer. There is no backward feedback signal between the layers, so it has certain limitations for simulating the real situation.

3.2 Neural Network Model and Deep Learning Algorithm

The so-called neural network is to connect many single "neurons" together, so that the output of one "neuron" can be the input of another "neuron". For example, the following figure shows a simple neural network with only one hidden layer and a neural network with multiple hidden layers and multiple output units.

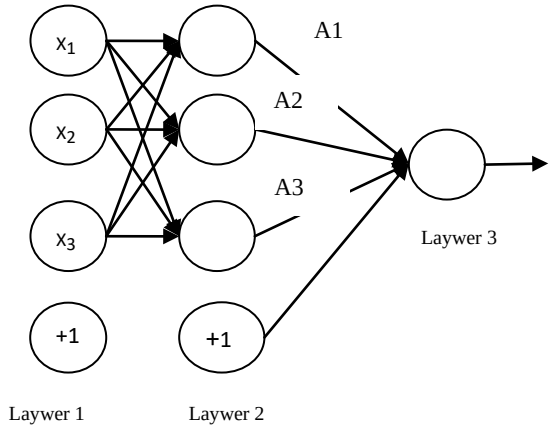

Figure 1 Simple neural network

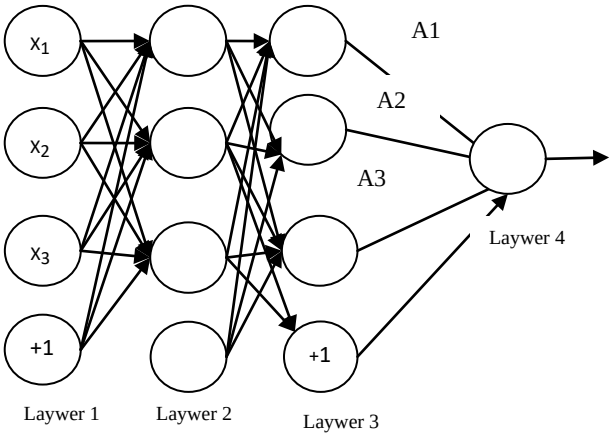

Figure 2 Multilevel neural network

Most current neural network learning methods are homogeneous shallow structure algorithms. Their limitation lies in their limited ability to represent complex functions with limited samples and computational units. For complex classification problems, their generalization ability is limited to some extent. Deep learning (DL for short) can learn a deep non-linear network structure to achieve complex function approximation and learn the essential characteristics of the data set from a small sample set. The essence of deep learning is to automatically learn more useful features by building a machine learning model with a lot of hidden layers and massive training data, thereby ultimately improving the accuracy of classification or prediction.

Different from traditional shallow learning, deep learning is different in the following aspects. The first is to emphasize the depth of the model structure. There are usually five, six, or even ten hidden nodes. The second is to clearly highlight the importance of feature learning. Through layer-by-layer feature transformation, learning layer by layer and passing the learned knowledge to the next layer, so that the next layer can get higher-level features, thereby making classification or prediction more It is fast and accurate, and can even reach similar conclusions as human intelligent recognition. Compared with the method of constructing features by artificial rules, using big data to learn features can better describe the rich internal information of the data, and more accurately describe the relationship between the changes in human life activities and interventions. DL uses a layered structure similar to neural networks. The system consists of a multi-layer network consisting of an input layer, a hidden layer (multi-layer), and an output layer. Disconnected from each other, each layer can be regarded as a logistic regression model. This layered structure is relatively close to the structure of the human brain.

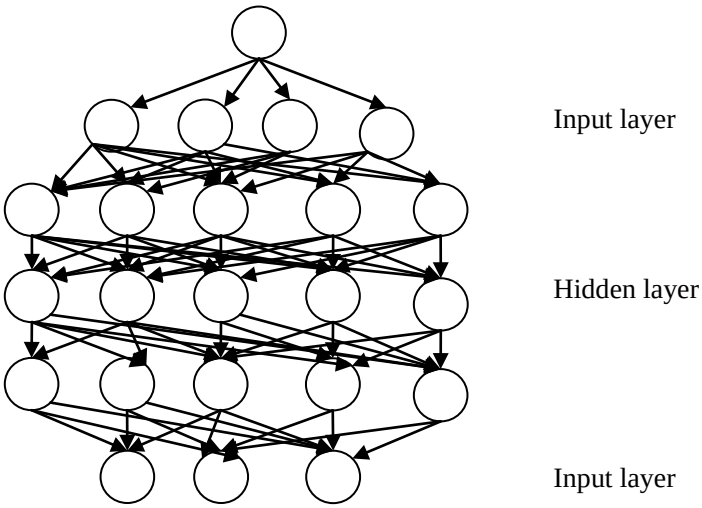

Figure 3 A neural network learning model with multiple hidden layers

4. Application of deep learning algorithms and neural networks in the intelligentization of traditional Chinese medicine

In the field of medical research, the relationship between variables is often very complicated. In order to detect the complex patterns between variables, neural networks are gradually becoming a popular tool for analyzing data. BP neural network is a widely used model. Its basic principle is to use a BP algorithm to let an artificial neural network model learn statistical rules from a large number of training samples, so as to make predictions on unknown events. This model is mostly used for clinical auxiliary diagnosis, such as auxiliary diagnosis of acute myocardial infarction, thyroid dysfunction, breast cancer, etc. For nonlinear modeling of TCM syndromes, an improved conjugate gradient learning algorithm was used to establish a three-layer forward BP network model of RA syndrome and DN syndrome, and the diagnostic value of the model was verified by the triple cross method. The results show that the average diagnostic accuracy rates are 90.72% and 92.21%, respectively, with high diagnostic and predictive capabilities, indicating that artificial neural network technology is a feasible method for nonlinear modeling of TCM syndromes. The disadvantage of BP network model lies in the following aspects. First, when the network is converged using the gradient descent method, the gradient will become increasingly sparse and easily converge to a local minimum. The convergence speed is slow, and the effect is not ideal even in the case of a small network level (3 or less). The second is that it is easier to overfit and the parameters are more difficult to tune. Third, we can only use labeled data for training, but most of the data is unlabeled, and we hope that the algorithm can learn from unlabeled data.

In order to overcome the problems in neural network training, DL uses a different training mechanism from neural networks. In traditional neural networks, iterative algorithms are used to train the entire network, randomly set initial values, calculate the output of the current network, and then change the parameters of the previous layers according to the difference between the current output and the label until convergence. And DL as a whole is a layer-wise training mechanism. In simple terms, the idea is that the output of this layer is used as the input of the next layer. The main idea is to train only one layer in the network at a time, and so on. In this way, hierarchical expression of the input information can be achieved. At the same time, the algorithm can be given unlabeled data and learn features using unsupervised learning. If these automatic learning features are added to the original features, the accuracy can be greatly improved.

5. Conclusion

Due to the various characteristics of TCM diagnosis and its complexity, and the existence of a large number of multicollinearity and synergy between the symptoms, it is difficult for the shallow neural network model to accurately simulate the complex relationship between symptoms and medication effects, and it is more difficult to describe. The real situation of TCM diagnosis and treatment. This requires that we must comprehensively collect all types of clinical diagnosis and treatment information, and use analysis, mining and reconstruction to form usable data to scientifically show the hidden rules of Chinese medicine. Although there is still a lot of work to be done in the dataization of clinical practice in traditional Chinese medicine, at least, deep learning algorithms have opened up new ideas for us in the research of traditional Chinese medicine big data. As a tool, it can provide a complex and non-linear hypothetical model, which can quickly and efficiently fit our data to achieve higher accuracy in diagnosis and prediction. Therefore, the application of this algorithm in traditional Chinese medicine big data processing will have a lot of research space.

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