Research and development of deep learning

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Abstract

With the gradual warming of artificial intelligence, the depth analysis of face recognition, speech recognition and text has been increasingly applied to our daily life. Deep learning establishes and simulates the human brain's hierarchical structure to extract the external input data's features from lower to higher, which can explain the external data. Combined with the domestic published six years of deep learning related academic and dissertation for statistical analysis. Firstly, it introduces the application background of deep learning technology and points out the importance of studying on deep learning technology. Secondly, it introduces three important deep learning models. Finally, the future research directions of deep learning are also discussed.

Keywords

Artificial intelligence, Deep learning, Application background, Neural network.

1.　Introduce

Deep learning algorithms originate from human imitation of brain neurons. In 2006, Hinton published a paper on deep learning A Fast Learning Algorithm for Deep Belief Nets. This paper really opens up a wave of academic and industrial circles about deep learning. Deep learning quickly develops subversive in the learning and understanding of voice, image and text[1-11]. There are also a lot of relevant literature on deep learning[12-20].

2.　The Basic Principle Of Deep Learning

Deep learning is essentially a kind of machine learning, focusing on the "depth" of the structure. Deep learning is made up of three parts: the input layer, the hidden layer and the output layer. In general, the number of hidden layers is more than two. The essence of deep learning is to use a lot of training data to build more hidden layer models to learn more useful feature data, so as to improve data classification effect and improve the accuracy of prediction results[21]. In terms of training model, the process of deep learning training model is bidirectional training, from input to output as the first link, from output to input as the second link. As shown in Figure 1.

The first link, deep learning from bottom-up training, every time only a layer of network training, training results as the next layer of input. The second link, deep learning from up-bottom training, mainly by using back propagation way to tune the parameters of each layer, because deep learning often have more than three layers of hidden layers, each layer of the parameter tuning is also a great influence on the result.
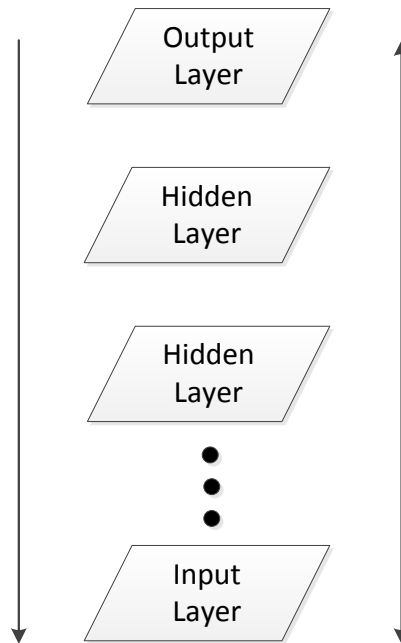
Figure 1 Training model of Deep learning

3. Contrast Between Deep Learning And Shallow Learning

From the perspective of algorithm network depth, machine learning can be divided into shallow learning algorithm and deep learning algorithm. The hidden layer of shallow learning is less, and does not involve the level of continuous abstract characteristics of the process, the algorithm compared to the depth of learning architecture is relatively simple. The difference between shallow and deep learning lies mainly in:

Target scene. At present, shallow learning is mainly used to solve some data analysis of log class, especially some prediction scenarios of structured numerical data. Deep learning focuses on complex feature scenarios such as image recognition, text analysis, and speech recognition.

Feature abstraction. In terms of characteristics of the processing, shallow learning mainly through manual build features, it need to have a lot of business background knowledge, but also depends on the manual way of feature extraction of extensibility not ready. The depth learning adopts automatic coding method, layer-by-layer abstract features, which has better effect on the complex feature extraction scene.

Training model. In the aspect of model training, shallow learning can be trained and optimized by a single layer gradient descent method because of the low level of architecture. In deep learning, it is often necessary to train and optimize the model through the two links from front to back and from the back to the front. In the process of model training, the partial derivative of the function between different levels should be considered[22].

4. Research Status Of Deep Learning

The literatures of this article are from CNKI. We use CNKI with the theme of "deep learning", the time span is set to be from 2012 to 2017, and journals ranking at the core and above. It searched 1013 articles. Analysis and Research on the literature searched. The annual volume of literature published is shown in Figure 2. The number of publications in the top 10 is shown in Figure 3. The key research content is shown in Figure 4.
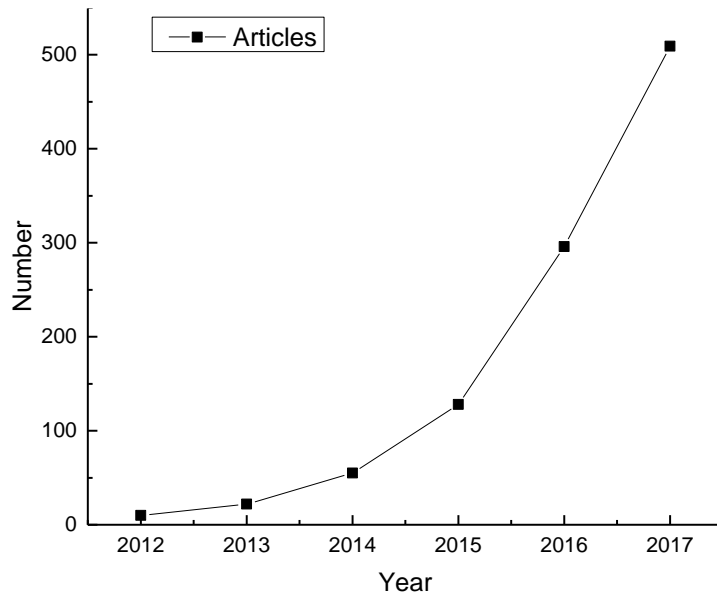
Figure 2 Periodical publication

As can be seen from Figure 2, since 2012, the trend of research on deep learning has been growing rapidly. From 2012 to 2014, the trend was relatively steady. From 2014 onwards, it entered the fast-rising channel. In 2014, the number of journals published was 10, but in 2017, it had reached 502. We can see that the hot research of deep learning is expected to show this popular research trend in the next few years.
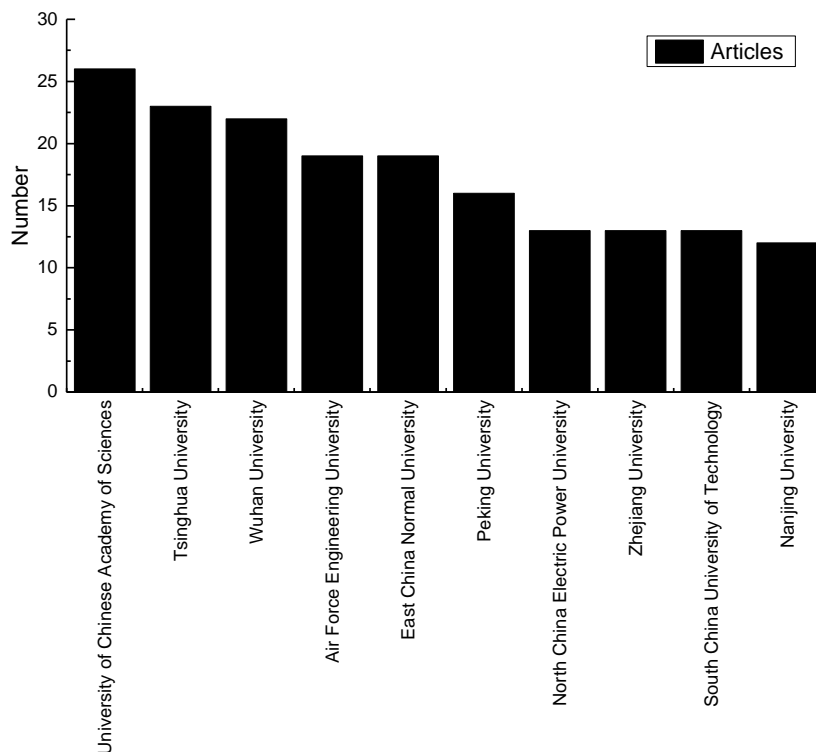

Figure 3 Research situation in Colleges and Universities

As can be seen from Figure 3, the top domestic academic institutions include the Chinese Academy of Sciences, Tsinghua University, Peking University, etc. are all involved in the study of deep learning, but also the leading force in the study of deep learning. And the depth of research institutions to institutions mostly.
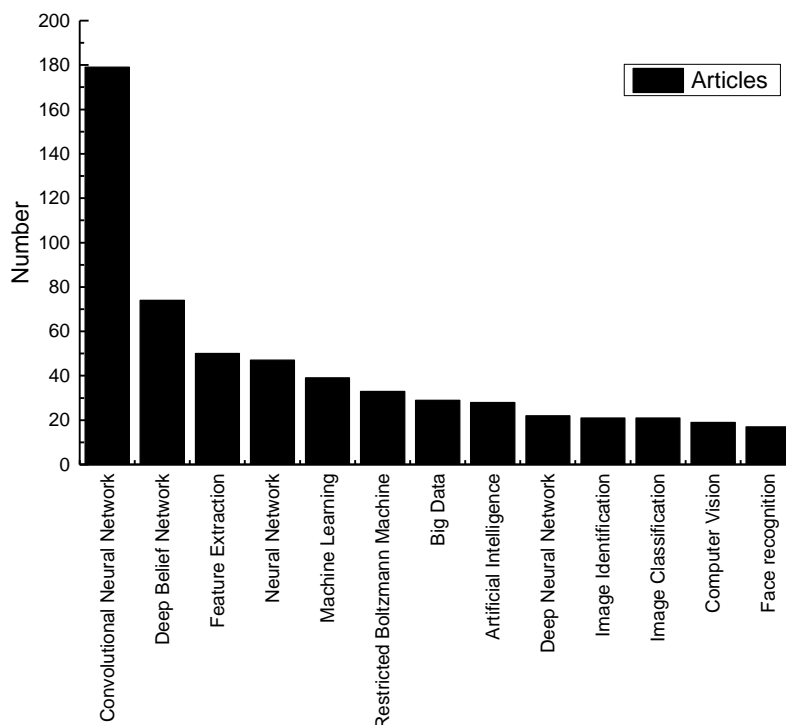
Figure 4 Content research

As can be seen from figure 4, the number of literatures of convolutional neural network is far more than that of other contents in the study of the content of deep learning. The deep learning methods involved include convolution neural network, deep belief network, restricted Boltzmann machine and so on. In content, it mainly include image recognition, image classification, computer vision, face recognition, etc. It can be seen that the study of deep learning is the most popular in classification and identification, and there are few studies on the regression of prediction. To sum up, the development of deep learning in recent years not only covers a number of fields, but also is listed as an important research direction by most of the top research institutions in China. In the future, its research will not be reduced.

5. Deep Learning Of The Classic Algorithm

There are many kinds of algorithms for deep learning. In this paper, the common deep belief network, convolution neural network and recurrent neural network are introduced briefly in this paper.

5.1 Deep Belief Network

Deep belief network (DBN) is a probability generation model. Compared with the traditional discriminant model of neural network, the generating model is to build a joint distribution between observation data and tags, and evaluate P(Observation|Label) and P P(Label|Observation), while the discriminant model only evaluates the latter, that is P(Label|Observation). DBNs consists of restricted Boltzmann machines, a typical deep belief network type as shown in Figure 5. These networks are "limited" to a visible layer and a hidden layer, with connections between layers, but no connections between the units in the layer. The hidden layer unit is trained to capture the correlation of higher-order data represented in the visual layer.
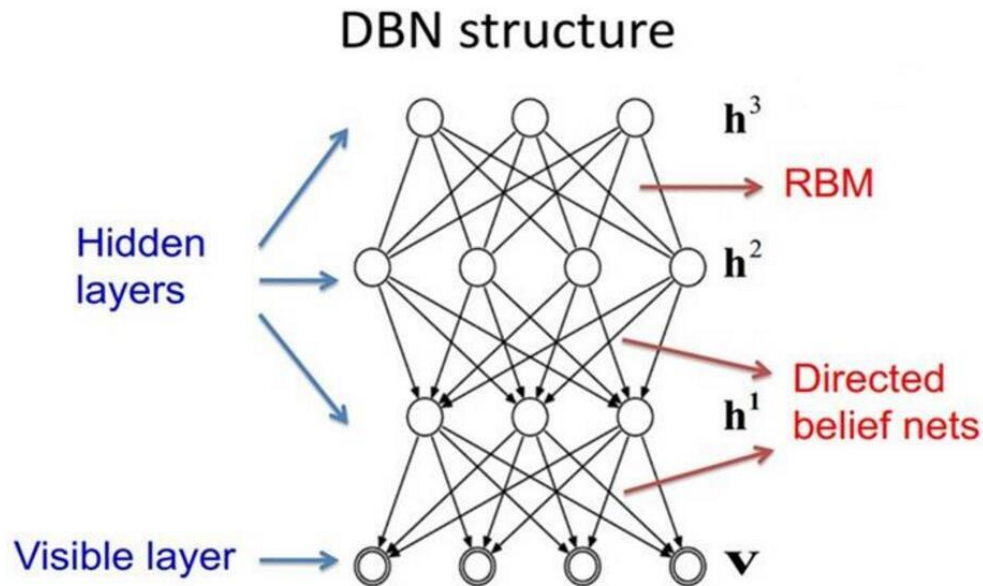
DBN structure

Figure 5 DBN structure

The component of DBN is RBM. The process of training DBN is carried out layer by layer. In each layer, the data vector is used to infer the hidden layer, and then the hidden layer is regarded as the next level data vector.

5.2 Convolutional Neural Network

Convolution neural network (CNN) is a feedforward neural network. Artificial neurons can respond to the surrounding units, and carry out large-scale image processing. Convolution neural network includes convolution layer and pool layer. The basic structure of CNN consists of two layers, one is the feature extraction layer, the input of each neuron is connected to the local acceptance domain of the previous layer, and the local characteristics are extracted. Once the local feature is extracted, its location relationship with other features is also determined. The second is the feature mapping layer. Each computing layer of the network consists of multiple feature maps, each of which is a plane and the weight of all neurons in the plane is equal.

The difference between convolution neural network and the ordinary neural network is that convolution neural network contains a feature extractor consisting of a coiling layer and a sub-sampling layer. In convolutional layers of convolutional neural networks, one neuron is connected to only a few adjacent neurons. In a convolution layer of CNN, there are several feature maps, each feature map is composed of some rectangular arranged neurons, and the neurons in the same feature map share the weights. The weight shared is the convolution kernel. The convolution kernel is usually initialized in the form of a random number matrix. In the training process of the network, the convolution kernel will learn a reasonable weight. The direct benefit of the shared weight (convolution kernel) is to reduce the connection between the various layers of the network, and also reduce the risk of overfitting. Sub-sampling is also called pooling, which usually has two forms: mean pooling and max pooling. Subsampling can be regarded as a special convolution process. Convolution and sub-sampling greatly simplify model complexity and reduce model parameters. The basic structure of convolutional neural network is shown in Figure 6.
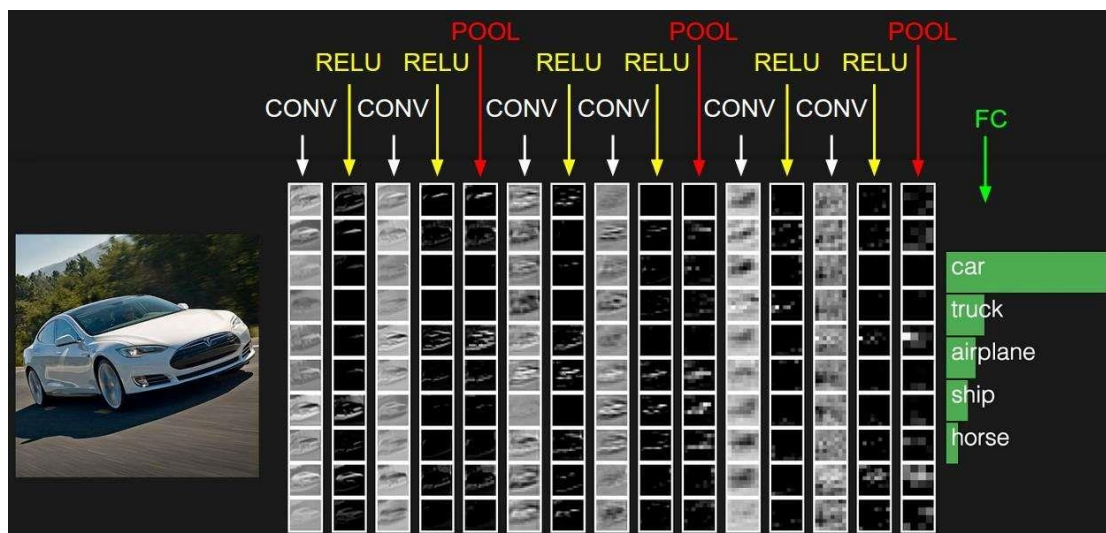
Figure 6 CNN structure

5.3 Recurrent Neural Network

Recurrent neural network (RNN) is a circular deep neural network, which is often used to deal with sequence data. And the current output of a sequence is related to the previous output. Specifically, the network memorizes the previous information and applies it to the calculation of the current output, the nodes between the hidden layers are connected, and the input of the hidden layer includes not only the output of the input layer, also includes the output of the hidden layer at the last moment. In theory, RNNs can process any length of sequence data. But in practice, in order to reduce complexity, it is often assumed that the current state is only related to the previous states. The structure of RNN is shown in Figure 7.
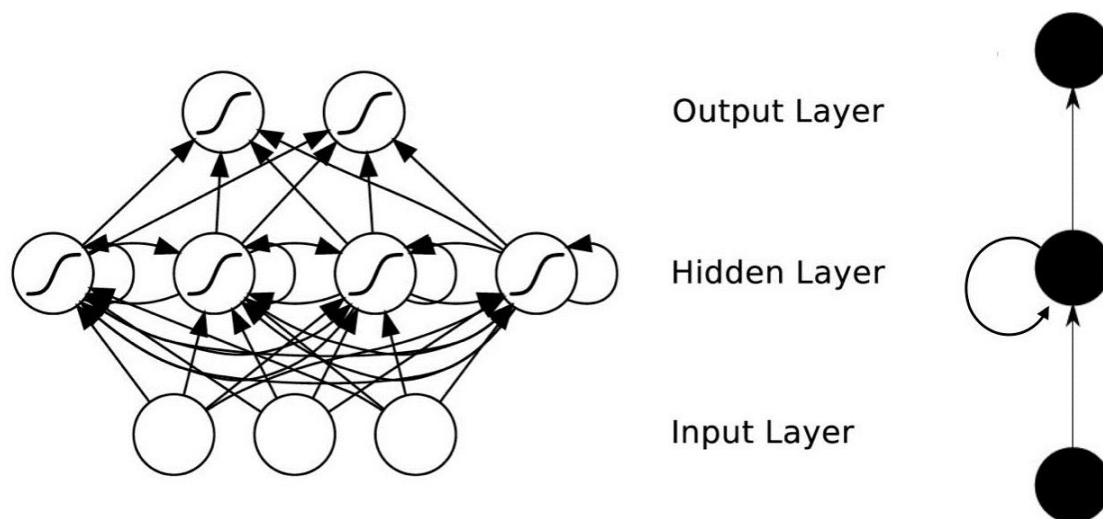

Figure 7 RNN structure

Over the past few years, the circular neural network has been widely used in speech recognition, machine translation, language model and timing analysis, and has achieved great success.

6. Conclusion And Prospect

The number of related literature in deep learning is increasing year by year, and the academic paper leads the research direction of deep learning. As a research field of machine learning, deep learning has attracted more and more attention in recent years. Many scholars have conducted extensive researches on deep learning. The study of deep learning involves almost all the universities in China, and the well-known universities in China have become the leading force in the study. In the study of the content of deep learning, the amount of literature of convolutional neural network is far more than

that of other contents. The main methods involved in deep learning are convolutional neural networks, deep belief networks, restricted Boltzmann machines, etc.. In content, image recognition, image classification, computer vision, face recognition and so on are the main contents. It can be seen that the study of deep learning is the most popular in classification and identification, and there are few studies on the regression of prediction.

Deep learning has been successfully applied to many classification problems. Although this area is in the early stage of development, its development will undoubtedly have a profound impact on machine learning and artificial intelligence system. Deep learning still has a lot of work to do, and the next few years will be a major subject.

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