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Application of deep learning in algorithm design

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Abstract. Deep learning has recently subverted algorithm design ideas in one and one fields, such as speech recognition, image classification, and text notification, by forming a model that begins with training data, goes through an end-to-end model, and then a new mode for direct output to obtain the final result. This not only makes everything easier, but because each layer in deep learning can tune itself for the final task, eventually cooperating between the layers, it can greatly improve task accuracy. This paper primarily introduces what deep learning is, the deep learning principle, and the application of deep learning in people's lives. This paper analyzes and clarifies the future development direction of deep learning and its practical application in many different fields, so as to offer some references for future studies.

Keywords: deep learning, machine learning, neural networks.

1. Introduction

With the development in recent years, deep learning starts to not only does make everything easier, but also because each layer in deep learning can tune itself for the final task, ultimately cooperating between the layers, it can greatly improve the accuracy of the task. With the advent of the era of big data and the development of various more powerful computing devices such as GPUs, deep learning has become even more powerful. It can make full use of various massive data and fully automatically learn abstract knowledge expressions, that is, condense the original data into some kind of Knowledge.

There is no doubt that deep learning is not necessarily the most perfect framework, and it is still far from the ultimate so-called intelligence, and there is basically no theoretical validity explanation at present. But in any case, the wind of deep learning has been unstoppable.

This paper mainly introduces what deep learning is, the principle of deep learning, and the application of deep learning in people's lives. The research significance of this paper is to analyze and clarify the future development direction of deep learning and its practical application in many different fields.

2. Analysis of deep learning

2.1. What is artificial neural networks

Operational models (machine learning models) called neural networks are made up of several nodes connected by connections. Each node stands for a distinct output function, also known as an activation function or excitation function. Each link between two nodes represents a value, and the artificial neural network's memory is comparable to the weight of the signal that passes through the connection.

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The connection mode, weight, and excitation function of the network all affect the output in different ways. The network itself often approximates a natural algorithm or function and can also be a manifestation of a logical plan [1, 2].

Deep Learning in Artificial Neural Networks (ANN), is really a "young technology" in recent years. With the research on Deep Learning, Artificial Neural Networks have already been used in many different areas and closely related to our life. Voice input and recognition, text/document extraction, or the most common photo search and translation of words in other languages in pictures. In addition, in many fields such as medicine, music, painting and 3D modeling, Deep Learning can make ANN grow rapidly.

2.2. What is deep learning

Deep learning is to learn the intrinsic rule and representation level of sample data. It is very helpful in the interpretation of data such as text, images and sounds by studying sample data, the information gained during the learning process. The ultimate goal of deep learning is to give machines the same ability to analyze and learn as humans, and be able to recognize characters, images, sounds and other data [1].

Deep Learning, much more achievements have been made in speech and image recognition than in previous related technologies, many common mobile apps are developed based on Deep Learning, for example: voice to word, image search, and artificial intelligence (AI) customer service [3].

2.3. Why deep learning important

In traditional machine learning (ML), usually choose human selects as the features and representations of the input and uses them as inputs to the ML algorithm. After that, the ML algorithm learns how to use these features to maximize classification accuracy. But in a DL system, characteristics are learned, not input. In the case of signal input, at the first layer of the DL system, it will learn the basic properties from the original input signal and pass the results to the second layer. The second layer learns the combination of features from this result, leading to more complex features, and so on. At the end of the neural network, we will get a high-level feature learned on top of all previous feature combinations and classify them. As Figure 1 shows, from tasks to outputs, different models are activated with the task step by step to let the network to "learn". Finally at the end of the entire network we can understand that the network has learned all the details and complete the outputs.

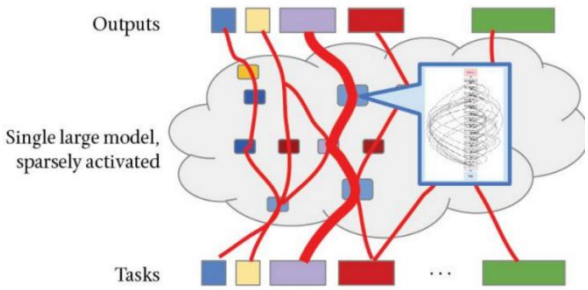

Figure 1. Module of machine learning [2].

People may be most concerned about the computational power gap or analysis improvement between the deep neural network and the single layer neural network, but a fact is that there is no big difference between the deep neural network and the single layer neural network in terms of results. Compared with the single layer neural network, the deep neural network is more like an iteration in the package. For a single layer neural network it might produce the same results as a deep network with an

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exponential number of neurons in a single layer. However, the birth of deep neural network is not to solve the problems that can be solved by single-layer neural network, but it faces more "deep" and "difficult" problems that single-layer neural network cannot solve.

2.3.1. ANN. Because deep learning uses some kind of artificial neural network technology, it must be taught with test data first. Through training, the neural network can be used for related tasks. "Reasoning" refers to the use of trained artificial neural networks. ANN compares the data provided with the rules learned during reasoning. For example, you can check for defects in objects in the input image.

2.3.2. Multiple layers and matrix. Multiple layers of interconnected "neurons" make up a neural network. In order to utilize the simplest diagram possible, these layers are specifically referred to as the input layer and the output layer. One can imagine a matrix of several neurons and connections. The value of the connection matrix combined with the output matrix, containing every value of the input matrix. The values of the connectivity matrix contain the weights of the connections. The weighted values of the input values and logic matrix values are used to generate corresponding values in the result matrix.

The Artificial Neural Network (ANN) consists of several layers of interconnected "neurons". In the simplest case, these layers explicitly represent the input and output layers. We can imagine a matrix composed of several neurons and connections. Each value in the input matrix is included in the connection matrix, and then connected to the value in the output matrix. The weight of the related connection is included in the value of the connection matrix. Use the weighted values of input values and logical matrix values to generate corresponding values in the result matrix.

2.3.3. Artificial neural network. Deep learning refers to the training of deep ANN. Between the input and output, there are usually hundreds of layers between the visible layers of the deep artificial neural network as figure1 showed. They calculate layer by layer like iteration, and take the results of the previous layer as the output of the next layer. Therefore, the results are only provided by the output matrix of the last layer [2].

3. Closer to people's daily

Deep learning has also brought some previously impossible tasks closer to their original goals. In people's common sense, electronic pets are generally cheap and synonymous with children's toys. Ten years ago, electronic pets usually had the shape of small animals, built-in simple chips, made random sounds, and could not move. Some of them are full of technical content. Voice recognition is possible. At the 2019 Latin American Robotics Symposium, Diego Renan Bruno proposed to develop a mobile robot platform that can avoid obstacles for the visually impaired [4]. Similarly, in construction a method has been proposed that uses deep learning-based 3D semantic segmentation to train a robot dog to model and monitor construction site scaffolding [5].

Also, for the e-shopping field that has gradually matured, people can use clickstream data to predict and recommend online shopping adds [6]. As mentioned above, through deep learning, shopping websites can better recommend their possible needs to users. The impact of deep learning can also be closer to people's daily lives. For example, the voice recognition feature on smartphones works much better these days. People are increasingly interacting with computers, whether with Amazon's Alexa, Apple's Siri, Microsoft's Cortana, or Google's many voice-responsive features.

Chinese search giant Baidu reports that customer use of voice interfaces has tripled in the past 18 months.

Image recognition has advanced. Google, Microsoft, Facebook, and Baidu all have features that allow search and automatic organization of photo collections, without identifying tags. People can ask the result of dogs, or snow, or even fairly abstract things like hugs. On the other hand in medicine zone,

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compared with current non-artificial neural network models, this predictive tool has been shown to have superior predictive power, providing a useful tool for diagnosis and early treatment [7].

4. Challenges and future trends of deep learning

4.1. Challenges

As a "young technology", the main challenge of deep learning is always the learning of samples or features. In order to increase the accuracy and recognition speed, a very large-scale database is required, which brings about a long learning period. Time and sample library are always the biggest challenges that deep learning cannot avoid. In addition, deep learning still has a great possibility of improving the recognition accuracy of small samples (such as pathological research and complex pictures), and this has to go back to the original sample library and insufficient database. Taking the medical image analysis mentioned by Djavavanshir as an example, how to analyze organs is currently the most challenging problem for deep learning, because the sample library is insufficient, and the analysis of organ shape and volume does not seem to have any depth at present. Learning methods can improve on this. For example, the most common CNN, although it can effectively identify whether there is a lesion in the current organ, and in some cases it can identify whether there is a tumor, but it cannot distinguish the lesion area from the healthy organ area, let alone how to put them in separated on the image [8]. For the FCN module, although it can classify and predict images at the pixel level, so as to meet our needs for segmenting pictures, as shown in Figure 2, for images of the same size, FCN can provide effective prediction classification, thereby locating tumors or other lesions in a desired manner. But for organs, because the lesion will change the size of the organ, in this case the FCN will become extremely weak in image detection.

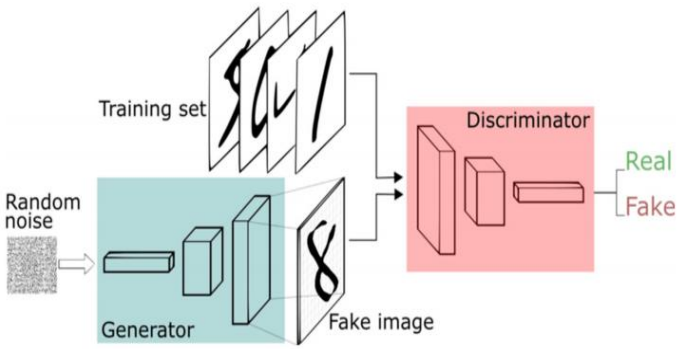

Figure 2. FCN module [8].

In addition, when the data is limited, if there is a regular situation, there will be the phenomenon of overfitting. To solve this problem, GAN believes that it can be a solution by providing simulated images as supplementary data, but it has not been effectively solved yet. Finally, deep learning also has cost problems. Compared with traditional algorithms, deep learning requires more layers of calculation and learning more complex samples and large databases, so the time and server costs far exceed traditional algorithms. However, deep learning still faces these problems. Compared with traditional algorithms, deep learning can significantly improve the machine's task processing ability after providing sufficient sample size. With the increase of sample size, the algorithm can be exercised and repetitive work can be reduced, thus significantly improving efficiency. On the other hand, compared with the traditional algorithm, the neural network of deep learning can have higher fault tolerance and acceptability of wrong input. In the case of the same data damage, deep learning does not need to deal with the damaged data and will not make such damaged data affect the result in a general direction [9].

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4.2. Future trends

Deep learning is often compared to the brains of humans and animals. In recent years, it has been found that ANN, as an important deep learning mode, is less efficient, flexible and versatile than biological network. The ultimate goal of artificial intelligence is to mimic the intelligence of ordinary people without the problems faced by current systems of in-depth research. In order to narrow AI and human intelligence, scientists have proposed a number of different ways. In recent years, there has been a lot of discussion on this, one of which is a combination of traditional neural networks and traditional symbolic systems of artificial intelligence. In the process of rational thinking of human beings in this field, symbolic operation is a very key link, but also a big problem. Leaders of the in-depth study believe that better network architecture will have profound effects on human and animal intelligence, including symbolic manipulation, reasoning, causal reasoning, and general knowledge. "Neural networks" specify an inherent frame of reference for objects and components and identify them by their geometric connections. This is known as the "capsule network". Using the "spatial" network, the neural network can be promoted from the detected features to the recognition of the physical properties of objects and their hierarchy. Capsule network can understand the three-dimensional world of human and animal "intuitive physics" in-depth research. In-depth research is like a baby. No one knows whether the current path is right or not, but so far, both the future direction and the existing benefits can make a huge difference.

5. Conclusion

From early neural network learning to the current deep learning, the mechanism is based on the structure of the brain and supplemented by certain learning algorithms, so that the way of computer work is as close as possible to the way of humans' work. The development of machine learning from a learning structure with only about two layers to a multi-layer structure is not only inspired by biological neurons, but also an improvement on the drawbacks of existing machine learning structures.

The brain has a deep architecture. First of all, the neuron system of the human brain is a huge structure, composed of countless neurons to complete certain physiological functions. For example, from the retina to the brain area that processes the retina, it needs to pass through countless layers of neurons to transmit visual information layer by layer, and finally reach the visual processing area of the brain, and then through information processing, the information is fed back to the muscle nerves, or the language area. This process is only instantaneous in the biological neuron system. However, the completion of this process is completed by the trained nervous system, and the nervous system's processing of the entire process is different from the cognitive process from birth to adulthood. not open. And all of this must be done with computers, not just by constructing simple artificial neurons. It requires large-scale neuron organization and connections, and is continuously strengthened and trained by external information. Therefore, structurally, the neural network structure should be deepened.

In fact, deep learning, as an algorithm for data analysis and extraction, is an inevitable result of data distribution. Taking human beings as an example, human cognition can make analysis and judgment to understand and process the received information, but the information is actually very complex. This is why it is necessary to build deep learning networks to imitate human cognitive activities for analysis. Although there has been no new progress in deep learning over the years due to its complexity and the limitations of the newly developed era, it has been greatly improved compared with traditional algorithms. Today, the success of deep learning has begun to affect People's Daily lives. Similarly, most of the deep learning applications currently being commercially deployed involve large companies such as Google, Microsoft, Facebook, Baidu, and Amazon, which have the vast amounts of data needed for deep learning computing to meet the sample needs of deep learning. Many companies are trying to develop more practical "chatbots" also known as automated customer service personnel. Deep learning may be most powerful when integrated into other AI technology portfolios in ways not yet thought of. For example, Google's DeepMind has achieved some surprising results by using deep learning in combination with a related technique called reinforcement learning. It used those two technologies to create AlphaGo, a system that once defeated world Go champion Lee Sedol. Therefore,

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with the progress of deep learning, the original goal of this technology, artificial intelligence, will eventually be achieved.

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