

# 중국의 심층학습개발

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## The Development of Deep Learning in China

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### Abstract

This paper is to summarize the academic status of deep learning in Chinese scientific institutions and universities based on the literatures from CNKI. We analyzed the various development of deep learning in China based on the application of computer vision, voice recognition and natural language processing.

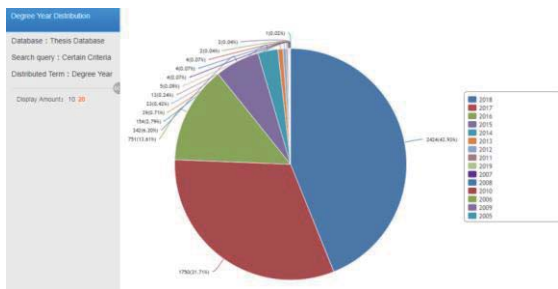
### 1. Introduction

Recently, deep learning has become one of the most important technologies in the field of artificial intelligence. In recent years, computer vision, voice recognition, natural language processing and explosive progress made by robots were inseparable from deep learning. Deep learning has been favored by artificial intelligence researchers and recognized by the industry. On March 27, ACM announced that Yoshua Bengio, Yann Lecun and Geoffrey Hinton, three founders of deep learning, won the Turing Award in 2019. In the last three years, deep learning has been rapidly developed and applied also in China.

### 2. Academic Achievements

China National Knowledge Infrastructure (CNKI) collected the latest research achievements of scientific and educational institutions in China. It was the most effective platform for knowledge dissemination and digital learning, and provided the abundant knowledge information resources.

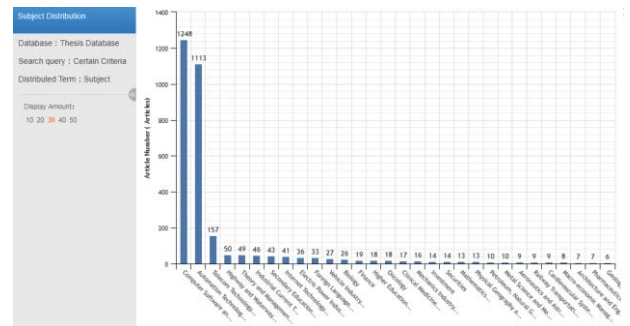
When the subject was defined as “deep learning”, the data was retrieved from CNKI various database. In theses and databases, there were 5,513 records during 2005 to 2018, including 551 doctoral theses and 4,962 masters’, as Figure 1.



(Figure 1) Data in Thesis Database

There was only one thesis in 2005, but 2,424 thesis in 2018.

Related subjects consisted with computer software and application, automation technology, telecom technology and others as Figure 2. Main research institutes included Beijing University of Posts and Telecommunications (344), University of Electronic Science and Technology (338), Harbin Institute of Technology (279), Xi'an University of Electronic Science and Technology (261), South China University of Technology (234).

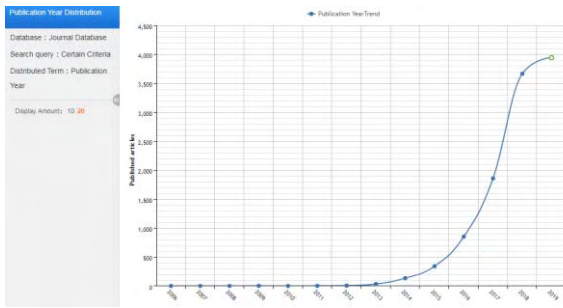


(Figure 2) the subject about deep learning

The details of related subjects about deep learning were in thesis database. There were 1,248 theses in the field of computer software and application, 1,113 theses in the field of automation technology, 157 theses in the field of telecom technology, and only 6 theses in the field of Geology.

In the Journal Database, the published papers were two in 2006, 3,664 in 2018, but reached 10,601 in 2019 as shown in Figure 3. The data was from CNKI on Mar.28, 2019.

From Figure 3 it was found that the study of deep learning started relatively late in China, but began to develop vigorously until 2016, with more and more institutions and disciplines participating in the deep learning study.



(Figure 3) Published articles in journal database

### 3. The Application of Deep Learning

The application of deep learning in China was mainly used in the fields of computer vision, speech recognition and natural language processing.

*A. Computer Vision.* There was a scientific and technical corporation founded in Feb. 2016, named “Sensingtech”, which applied neural network algorithm to image and face recognition technology, and extracted human facial details with multi-layer convolution. The main idea of their algorithm was to generate the feature network, then to carry out measurement learning following to judge comprehensively the multi-path parameters. Finally, the algorithm with high recognition ability to train successfully. And now, it was applied to the “Skynet project” of the Ministry of Public Security, as shown in Figure 4.



(Figure 4) The monitor of “Skynet project”

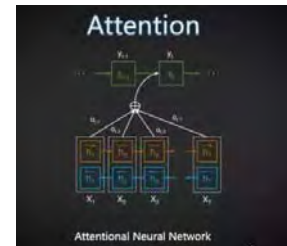
John Sudworth, a BBC journalist, recently went to Guiyang, to experience the local monitoring system “Skynet Project”. After being photographed by his mobile phone and scanned and registered as a suspect, he was captured by the police only seven minutes after his absconding.

The “Skynet project” integrated face recognition technology, network database technology, parallel processing technology, portrait combination technology, blurred image restoration technology, video image acquisition and processing hardware technology into an efficient and practical recognition system. At present, the system tested by examples was assigned in 15 provinces, which could recognize mobile faces in 7 seconds, and the accuracy rate was over 90%.

*B. Voice Recognition.* The many institutes and companies such as iFLYTEK, Baidu and the Institute of Automation of the Chinese Academy of Sciences have made great breakthroughs in voice recognition through deep learning. Domestic smart phones basically realized the voice input of Chinese characters, which brought great convenience to

everyone. In the streets and lanes of China, mobile phone users with voice input could be seen everywhere.

*C. Natural Language Processing.* In the field of natural language processing, iFLYTEK was in the leading position, which applied deep learning to DNN voice recognition from 2010. The first Chinese voice recognition DNN system was on line in 2011, the first BN-ivec technology in language recognition was initiated in 2013, and the attention model neural network used in cognitive intelligence in 2016 as shown in Figure 5.



(Figure 5) The attentional neural model from iFLYTEK.

Not long ago, Baidu launched Content-Matching-Matrix, a deep learning model in the field of search intellectualization, which successfully depicted the semantic relevance of indexed object content for the first time and provided details of semantic matching. On the basis of infrastructure, it triumphantly developed ranking-service search intellectualization architecture, and introduced GPU into large-scale search engine online semantic correlation calculation for the first time millisecond operations for searching complex semantic models.

Content-Matching-Matrix model introduced index object body, and used extractive automatic summarization algorithm extracted several paragraphs from the index object body as a summary, which alleviates the asymmetric problem of long text matching to a certain extent. In the model structure, a new pooling structure based on semantic matching matrix was adopted, which could describe the matching degree between search terms and index objects from multiple dimensions. After obtaining the text summary, considering the context, the content semantic matching matrix was constructed, and the semantic matching information of larger fragments is obtained by using Pooling method. Then Topk-Average-Pooling was carried out according to the term dimension to obtain the semantic matching information of each term of the search term, and the GRU structure was used for the serialization modeling. The final unit is selected as the final fusion representation of Query-Title-Content.

### 4. Conclusion

Although deep learning started late in China, the technical support of the state in the field of AI has brought infinite business opportunities to high-tech research institutions and enterprises. Many of Chinese high-tech practitioners have the experience of studying abroad. They have mastered advanced technology, and have the support with national policies. It was trust that the study of deep learning will be more in-depth.

### REFERENCES

- [1] <https://www.cnki.net>
- [2] <https://www.baidu.com>