

Statistics and Visualization of Artificial Intelligence Research in China in the Past 21 Years by UCINET

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Abstract

With the release of many documents on artificial intelligence by the Chinese government, artificial intelligence research has become a new wave. In this context, from the perspective of the industrial chain, this research uses the AI-related literature collected by CNKI from 1998 to 2019 for 20 years as a research sample. It uses co-word analysis and social network analysis to find: Artificial intelligence research is more closely related Chinese artificial intelligence research is more fragmented, less concentrated, and the degree of industrial integration is average. It is suggested that scholars strengthen the data quality, broaden the research scope of artificial intelligence technology, and pay attention to the research on business applications related to artificial intelligence with a view to making feasible suggestions for the development and integration of artificial intelligence industry.

Keywords

Artificial intelligence; knowledge map; research central issues.

1. Introduction

Artificial intelligence (AI) usually refers to a computer program that can think like a human. It was first proposed by McCarthy and Minsky at the first artificial intelligence seminar in 1956 [1]. The development of Chinese artificial intelligence industry can be traced back to the establishment of the Artificial Intelligence Society for the first time in 1981, which indicates that Chinese artificial intelligence has begun to enter systematic research. At the end of the nineteenth century, Chinese low economic aggregate, insufficient level of information technology development, and low government attention to the artificial intelligence industry made the development of the artificial intelligence industry slow. Until 2017, the State Council issued a New Generation Artificial Intelligence Planning policy document. China Formally entered the era of artificial intelligence 2.0. With the guidance of policies, the number of researches related to artificial intelligence topics in China has surged. In this context, what are the research central issues of Chinese scholars? What are the shortcomings of existing research? In what areas will future research keep up with the times? Based on this, this article selects the CSSCI literature data on artificial intelligence as the search subject from CNKI from 1998 to 2019, and uses the knowledge map software to sort out the current situation of artificial intelligence development in China, research central issues, and put forward feasibility suggestions for scholars' reference.

2. Background of Chinese Artificial Intelligence Research and Development

At the basic layer, computing power and data help artificial intelligence research continue to advance.

Data, algorithms and computing power are the three basic elements for the development of the artificial intelligence industry. Judging from the data, Chinese data service industry has begun to enter a stable growth stage, which has laid a certain foundation for the research of artificial intelligence algorithms. From the perspective of computing power, with the release of the Integrated Circuit related policies and related companies after the China-U.S. Trade friction increasing emphasis on core technology research and development, China has begun to increase research and development efforts in high-end processors and high-end chips. The continuous implementation of basic research has provided a favorable guarantee for artificial intelligence research.

At the technology layer, the introduction of eight core technologies to guide artificial intelligence research.

The New Generation Artificial Intelligence Development Plan proposes to focus on eight key common technologies such as cross-media analysis and reasoning, natural language processing, and virtual reality modeling, and guides Chinese artificial intelligence technology research from the top-level design.

At the application layer, extensive application scenarios drive artificial intelligence research to achieve faster landing.

Whether it is the development of Smart Medical or the maturity of Smart e-commerce, Chinese artificial intelligence technology has a wide application industry and a large user base. Chinese artificial intelligence application layer enterprises account for 60% [2]. A wide range of application scenarios and a large number of application-layer companies can help related technology research land faster and achieve industrial maturity faster, thereby driving the development of artificial intelligence research.

3. Quantitative Analysis of Artificial Intelligence Research

This article uses CNKI as a sample source platform, and selects "artificial intelligence" as the topic word in the advanced search. The time range is from 1998 to 2019. With "CSSCI" as the journal source, a total of 5,037 articles have been retrieved. After weighting, 4659 articles were finally selected. Statistics and visual display of artificial intelligence research in China over the past two decades were made on the amount of publications in the sample, the co-occurrence of source journals, and keywords, combined with social network diagrams.

3.1. Artificial Intelligence Research Trends

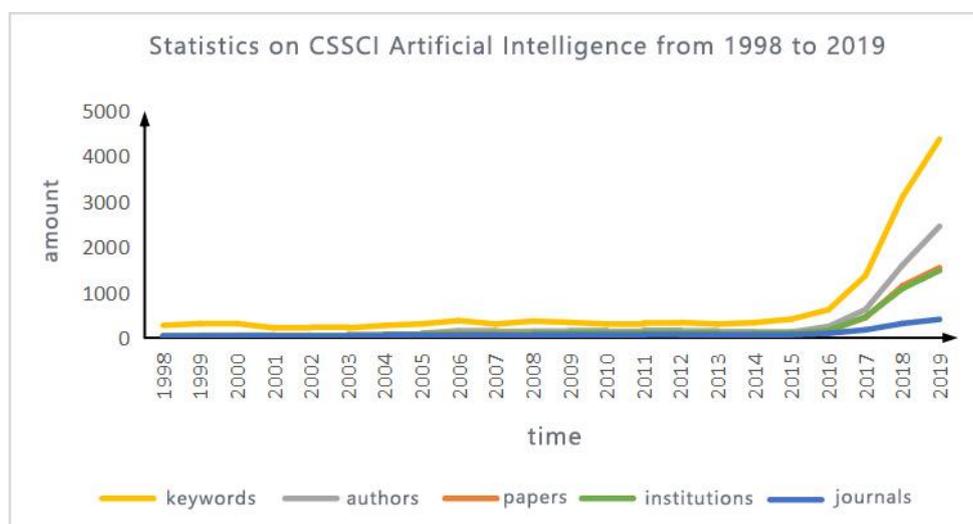


Fig 1. Statistics on artificial intelligence literature from 1998 to 2019

Since 1998, the number of publications, number of keywords, number of authors, and research institutions of artificial intelligence in China has shown an upward trend. In 2016, it began to blow out. Since China implemented the Strategy of Revitalizing the Country through Science and Education in 1995, domestic scholars have adhered to the central government's guidance of science and technology as the first development force, and CNKI has begun to display research records on artificial intelligence. From the late 1990s to before 2005, the number of Chinese paper on artificial intelligence has been rising at a steady rate. The launch of the celebration of the 50th Anniversary of Artificial Intelligence in 2006 [3] caused the first peak in the number of Chinese artificial intelligence research papers, with a total of 93 publications, nearly double the number of papers in 1998. After 2016, there has been a significant increase in the number and scope of AI research, as well as the number of participating scholars. The number of publications and authors has increased by about 70% in just one year. From a government perspective, this has benefited from the The issuance of the three policies of Made in China 2025, Robot Industry Development Plan (2016-2020) and Internet + Three-Year Action Plan for Artificial Intelligence, clarified the strategic position of Chinese artificial intelligence industry. In terms of level, the artificial intelligence Alpha dog developed by Google in 2016 defeated the Korean Go player Shishi Li, causing many Chinese scholars to re-examine artificial intelligence. At present, artificial intelligence technology has penetrated into education, medical care, service, manufacturing and other industries, and its related disciplines have also become one of the most popular majors in universities and the highest demand of enterprises.

3.2. Analysis of Source Journals

From the perspective of AI source journals, pedagogy-related journals have the highest frequency. Among the top 15 top journals, a total of five pedagogical journals have appeared, namely Modern Education Technology, Journal of Distance Education, China Electrification Education, Open Education Research. They have appeared 406 times in total. In the context of the era of artificial intelligence, how to develop pedagogy has become the focus of scholars' inquiry, and how to apply artificial intelligence technology in pedagogy to cultivate artificial intelligence talents has attracted more attention; in addition to education, Outside of school, a total of three media-oriented journals appeared, namely Media, News and Writing, and Publishing Wide Angle, appearing 205 times in total. Intelligent media is superior to traditional media in terms of interactivity and speed of transmission. Big data and personalized recommendation algorithms can learn more about user interests and increase user stickiness. Therefore, how traditional media can transform into smart media is worth investigating. Taken together, the education industry and the media industry are the key areas of convergence for artificial intelligence.

3.3. Keyword Co-occurrence Analysis

After the keywords are replaced with synonyms and the invalid keywords are deleted, statistical analysis is performed. After analysis, it is found that in the artificial intelligence entire industry chain, the research on application aspects accounts for the largest proportion, followed by technical research. There is a lot of research on the ethics of artificial intelligence. Will machines have the ability of humans to understand ethics? How to break through machine ethics and other issues determines the upper limit of the development of artificial intelligence. From the perspective of industrial foundation, big data is still a hot topic for scholars. From the perspective of industrial technology, deep learning and machine learning appear more frequently in algorithm theory. In the application technology, the semantic network attracts the most attention. From the perspective of the industrial application layer, the number of intelligent education researches is the largest. This can be attributed to the current government's attention to both talent training and Educational Information. Sexual and

intelligent performance make up for the shortcomings of traditional teaching methods, less access to knowledge for students, difficulty in teaching according to their aptitude, and promote the rapid and efficient development of the education industry.

The co-occurrence matrix was obtained by co-occurrence statistics of high-frequency words using SATI software. From the perspective of research at the basic layer, the frequency of the occurrence of artificial intelligence and big data is high. Data is used as the nourishment of artificial intelligence. The maturity of its technology determines the speed and quality of artificial intelligence development. From the perspective of technical research, artificial intelligence the high frequency of occurrence of machine learning and machine learning indicates that machine learning is a research central issue in this field. From the perspective of application layer research, artificial intelligence and robots have the highest frequency of co-occurrence. Robots are the main end products of artificial intelligence. It is easier to implement technology. The data in the dissimilarity matrix is dissimilar data. The larger the value is, the longer the distance between the keywords is, and the worse the similarity is; on the contrary, the smaller the value is, the closer the distance between the keywords is, the larger the similarity is. [4]. It can be seen from Table 1 that the dissimilar data of artificial intelligence and big data, artificial intelligence and robots, artificial intelligence and machine learning are smaller, and the distance between the two keywords is closer and more similar.

Table 1. Keyword co-word (dissimilar) matrix (partial)

	Artificial Intelligence	learning	Robot	Big Data	Intelligent Education	algorithm	Deep learning	Machine learning	Intelligent	Semantic web
Artificial Intelligence	2587 (0.0000)	3 (0.9969)	182 (0.7971)	156 (0.7893)	38 (0.9278)	44 (0.8966)	45 (0.8943)	49 (0.8814)	16 (0.8590)	4 (0.9898)
learning	3 (0.9969)	372 (0.0000)	0 (1.0000)	3 (0.9893)	0 (1.0000)	0 (1.0000)	0 (1.0000)	2 (0.9872)	0 (1.0000)	0 (1.0000)
Robot	182 (0.7971)	0 (1.0000)	311 (0.0000)	3 (0.9883)	0 (1.0000)	1 (0.9932)	0 (1.0000)	0 (1.0000)	0 (1.0000)	0 (1.0000)
Big Data	156 (0.7894)	3 (0.9898)	3 (0.9883)	212 (0.0000)	5 (0.9668)	11 (0.9097)	3 (0.9754)	3 (0.9746)	4 (0.9642)	0 (1.0000)
Intelligent Education	38 (0.9278)	0 (1.0000)	0 (1.0000)	5 (0.9668)	107 (0.0000)	0 (1.0000)	3 (0.9653)	1 (0.9881)	0 (1.0000)	0 (1.0000)
algorithm	44 (0.8966)	0 (1.0000)	1 (0.9932)	11 (0.9097)	0 (1.0000)	70 (0.0000)	3 (0.9571)	0 (1.0000)	1 (0.9844)	0 (1.0000)
Deep learning	45 (0.8943)	0 (1.0000)	0 (1.0000)	3 (0.9754)	3 (0.9653)	3 (0.9571)	70 (0.0000)	8 (0.8823)	0 (1.0000)	0 (1.0000)
Machine learning	49 (0.8814)	2 (0.9872)	0 (1.0000)	3 (0.9746)	1 (0.9881)	0 (1.0000)	8 (0.8823)	66 (0.0000)	0 (1.0000)	1 (0.9840)
Intelligent	16 (0.9590)	0 (1.0000)	0 (1.0000)	4 (0.9642)	0 (1.0000)	1 (0.9844)	0 (1.0000)	0 (1.0000)	59 (0.0000)	1 (1.0000)
Semantic web	4 (0.9898)	0 (1.0000)	0 (1.0000)	0 (1.0000)	0 (1.0000)	0 (1.0000)	0 (1.0000)	1 (0.9840)	0 (1.0000)	59 (0.0000)

3.4. Keywords Network Graph Analysis

UCINET was used to perform statistical analysis on high-frequency keywords in the sample to obtain a social network diagram of high-frequency keywords. Network graph In social networks, the relationship between nodes has a certain effect on the transfer of knowledge. The closer the nodes are, the higher the efficiency of knowledge transfer [5]. From the figure, artificial intelligence and big data, artificial intelligence and robots, artificial intelligence and education are more closely linked, and related theories and research transfers and applications are more efficient. The centrality of node degree of big data is the highest, indicating that it is the most important in the network graph, followed by robots. From the perspective of applied research, it is mainly concentrated in education and libraries. The eight core technologies proposed by the New Generation Artificial Intelligence Plan, such as natural language processing, virtual reality, and human-machine collaboration, are mainly distributed around

the network. The centrality of the keywords on the periphery of the network is small, but the number of peripheral nodes is large. From the perspective of disciplines, artificial intelligence research has also attracted scholars' attention in the fields of business management, news communication, philosophy and law. The continuous research on the problem of artificial intelligence talents and the protection of intellectual property rights is conducive to the healthy development of the artificial intelligence industry.

4. Conclusions and Recommendations

The number of artificial intelligence research, academic participation, and research scope are generally on the rise, but the research is scattered and not highly concentrated. From the perspective of the basic layer, there is less research on computing hardware such as AI chips. From the perspective of the technical layer, Machine Learning and Deep Learning have been concentrated in algorithm theory, but other key technologies such as Natural Language Processing, Virtual Reality, and Man-machine Collaboration. The scale of the industry has not yet formed. From the perspective of application-level research and industry applications are mainly concentrated in education and libraries. The number of integration with other industries is relatively small. Research on other product applications such as Wearable smart devices other than robots is insufficient. Therefore, the following recommendations are made: First, deepen data research and enhance the relevance of artificial intelligence technology. Data, as one of the three basic elements of the artificial intelligence industry, is spread across the entire artificial intelligence industry chain. Although Chinese current big data research has formed a certain scale, it still faces many challenges in terms of data classification and data fusion. In addition, there are obvious differences in the interconnections between artificial intelligence technologies. From the perspective of technological associations, scholars can study artificial intelligence technologies in subdivided areas and give high priority to those with low relevance.

Second, use the barrel effect to strengthen the research of artificial intelligence short board. Chinese number of artificial intelligence papers or patents are among the highest in the world. However, the concentration of key technologies such as natural language processing, virtual reality, and human-machine collaboration needs to be strengthened. On the one hand, scholars need to increase the number of related technical studies, on the other hand, they are recommended to actively seek technological breakthroughs to increase the quality of Chinese artificial intelligence research.

Third, improve application orientation and focus on the commercial implementation of artificial intelligence research. Most of the research on artificial intelligence is still in theoretical research, and there are still differences between theory and practice. For example, in terms of intelligent education research, although there are a large number of researches, but it has been implemented in practice. Intelligent education also has inconsistent data platforms and insufficient machine learning capabilities. , Lack of independent capabilities and other issues, did not really achieve the commercial landing of technology. With their tangible displays, smart wearable devices, smart robots, and other products can be accepted by the market as soon as possible, and they can be easily commercialized. Scholars can refer to their research models to increase the possibility of artificial intelligence technology landing in other industries.

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