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Artificial intelligence: a review of development, application and prospects

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Abstract:

This paper summarizes the development process, current application and prospects in the field of artificial intelligence (AI). First, the paper reviews the origins and key breakthroughs of artificial intelligence and then discusses the common AI technologies and their applications in various fields, including machine learning, natural language processing, computer vision, robotics, and intelligent control. Finally, the future development of AI is explored, and possible challenges and opportunities are discussed. Through this introduction, readers will be able to have a deeper understanding of the core AI principles, application areas, challenges, and key technologies that support its development.

keywords: Artificial intelligence, machine learning, deep learning, natural language processing, computer vision, and robotics

Foreword

Artificial intelligence is a collection of computer science, logic, biology, biology, psychology, philosophy, and linguistics. It is an important branch of computer science, aiming to develop and apply theories, methods, and technologies that can simulate, extend, and extend human intelligence. With the rapid development of technologies such as big data, cloud computing, and deep learning, artificial intelligence has become an important force driving social progress.

1. Definition and core of artificial intelligence

The definition of artificial intelligence can be divided into two parts, namely "artificial" and "intelligence." Professor Winston of the Massachusetts Institute of Technology pointed out in his book Artificial Intelligence: " Artificial intelligence is the work of studying how to make computers do the intelligence that only human beings could do in the past." Professor Nilson at Stanford University in the United States said:" Artificial intelligence is a subject of knowledge, which is the discipline of how to represent, acquire and use knowledge."[1]

The core of artificial intelligence lies in the simulation of the human thinking process, including learning, reasoning, thinking, planning, and so on. By making the computer have these capabilities, artificial intelligence technology can deal with complex tasks, solve various problems in real life, improve productivity and efficiency, safety protection, health, personalized education, traffic management, disaster management, and other fields have shown strong application potential and value, is gradually changing the way people live and work [2][3][4][5][6].

2. The development process of artificial intelligence

2.1 Breeding: the accumulation and collision of wisdom

Thousands of years of wisdom accumulation and collision have provided a deep soil for the breeding of artificial intelligence. Around 335 BC, the ancient Greek philosopher Aristotle proposed the deductive logic. In the 17th century, the German philosopher and mathematician G.W. Leibniz tried to build a thought machine with a symbolic logic system. In the late 19th to 20th centuries, the biologist W. James elaborated on the structural function of the human brain and provided a biological basis for neural network model design. Claude Shannon IT proposed to use "1" and "0" to represent the basic units of information and promote the development of digital circuits and binary information theory. Warren McCulloch and Walter Pitts cooperated to establish the first neural network model, MP, which provided a framework for neural network research. Donald Hebb introduces the concept of artificial

neural networks based on neuropsychology to provide a theoretical basis for changing the strength of neural network connections. In 1950, Minsky and Edmonds built the first neural network computer, and Turing proposed the Turing test as the standard for machine intelligence determination [7]. In 1955, the LOGIC THEORIST program developed by Newell and Simon was considered to be the first AI program, marking the formal birth of the AI field.

2.2 Birth: Overture and Discipline Laying in the AI Era

The 1956 Dartmouth conference marked the official birth of artificial intelligence. At this historic conference, scientists including John McCarthy, Marvin Minsky, Claude Elwood Shannon, and others not only put forward the epoch-making concept of "artificial intelligence" but also clarified the status of artificial intelligence as a research subject. Shortly after the meeting, McCarthy and Minsky created the world's first artificial intelligence laboratory, the ——MIT AI LAB Laboratory, which provided an important platform and support for AI research.

2.3 Development: Journey of simulated thinking and breakthrough in machine learning

In 1957, Allen Newell and Herbert A. Simon et al. developed the Logic Theorist program, marking the beginning of the computer program simulating the human mind [8]. In the same year, Frank Rosenblatt's mathematical model of perceptron became the core and origin of intelligent machines. Then, in 1958, John McCarthy invented the Lisp language, which became the first widely popular language in the field of artificial intelligence. The reinforcement learning method proposed by Sutton and Barto provides new learning mechanisms for AI development. In the 1970s, artificial intelligence moved from theory to practice, and knowledge engineering and expert systems became the mainstream [9].

In the 1980s, machine learning became a research hotspot in the field of AI. The "Decade of Neuroscience Project," launched in the United States, closely combines AI visual, auditory, perception, and robotics research with brain science, promoting the development of AI in the field of cognitive science. At the same time, Japan's fifth-generation computer project aims to develop computers with language processing, image recognition, and reasoning capabilities. At this stage, connectionism is revived, emphasizing the importance of neural networks and machine learning. Many scholars have put forward innovative algorithms and models, such as self-organization mapping neural networks, multi-layer perceptron, etc., which provide technical support for the rapid development of AI.

2.4 Metamorphosis: the rise and wide application of deep technology

In the 1990s, with the popularization of Internet technology, the development of AI entered a stable stage, and deep learning research arose. In 2006, Geoffrey Hinton et al. proposed the concept of deep learning to promote the rapid development of AI. Subsequently, deep learning models such as convolutional neural networks (CNN) were proposed. In 2015, DeepMind's Deep-Q-Network algorithm combined reinforcement learning with deep learning, and AlphaGo was designed to beat Go world champion Lee Sedol in 2016, pushing the development of AI to a new height. In recent years, AI has rapidly penetrated and integrated into all walks of life to reshape the development of society as a whole. "Intelligence + X" has become the innovative model of artificial intelligence application [10].

2.5 Future: Intelligent upgrading and social change

In the future, with the continuous progress of technology and the continuous expansion of application scenarios, AI is expected to achieve a higher level of intelligence and bring more convenience and innovation to human beings.

3. Common technologies of artificial intelligence

3.1 machine learning

Machine learning is the core of artificial intelligence and is also the central problem [11]. It gives computers the ability to draw wisdom from huge amounts of data, automatically optimize algorithms, and then constantly improve their execution of specific tasks. Machine learning has a broad technical landscape, including supervised learning, unsupervised learning, semi-supervised learning, integrated learning, and reinforcement learning [12] [13]. These techniques are not isolated, and they can combine and complement each other to form more complex machine-learning models and solutions.

3.2 deep learning

Deep learning is a sub-field of machine learning that simulates the structure and function of the human brain's neural networks to realize machine-autonomous data learning. The essence of deep learning is to learn more useful features by building machine learning models with many hidden layers and massive training data so as to ultimately improve the accuracy of classification or prediction [14]. As an important tool for deep learning, neural networks have given birth to a series of innovative technologies such as convolutional neural network (CNN), recurrent neural network (RNN), and generative adversarial network (GAN), which have each shown strong application

capabilities in image processing, natural language processing, and data generation.

3.3 Natural Language Processing

Natural language processing is one of the important applications of artificial intelligence, which is mainly used for the processing and understanding of human language. Its common technologies include entity extraction, relationship extraction, knowledge aggregation, etc., which are used to extract information from text, analyze semantic relationships, and build knowledge graphs.

3.4 computer vision

Computer vision is the science of studying how to make machines "see", enabling computers to understand and analyze images and video content. Commonly used technologies include image recognition, target detection, image segmentation, etc., which involves the use of cameras and computers to replace human eyes to identify, track, and measure targets and other machine vision tasks and further do graphics processing so that computer processing is more suitable for human eye observation or transmitted to the instrument detection images.

3.5 expert system

An expert system is an intelligent program system that combines artificial intelligence technology and computer technology. It uses the knowledge and experience of field experts to simulate the decision-making process of human experts through reasoning and judgment and solve complex problems. The expert system not only promotes artificial intelligence from theory to practice but also realizes the significant change from the general reasoning strategy to the application of specialized knowledge.

In addition, transfer learning, big data, knowledge graph, quantum computing, brain-computer interface, and other technologies are actively promoting the development of artificial intelligence. These technologies have not only made significant progress in their respective fields but also in the process of mutual integration and innovation, just like the sparks of wisdom in the gestation period, jointly promoting the continuous breakthrough of artificial intelligence technology and the extensive expansion of application.

4. Cross-field application and innovation engine of AI

Artificial intelligence, as an outstanding representative of modern science and technology, is expanding and deepening at an unprecedented speed, penetrating almost every aspect of our lives and becoming an important innovation engine to promote social progress.

4.1 Lead the intelligent transformation of the industry

In the field of industrial production, the application of artificial intelligence makes the production process more intelligent and more efficient. Machine learning machines autonomous learning and prediction by training and optimizing models. This technology assists doctors in medical diagnosis to identify lesions and improve diagnosis accuracy; optimize flight trajectory in aerospace and improve flight efficiency; accurately predict cargo demand in intelligent logistics and reduce inventory cost; accelerate new material discovery in materials science and promote technological progress; analyze earthquake precursor in earthquake prediction and warning to reduce disaster losses.[15][16][17][18][19].

4.2 Innovate the human-computer interaction experience

With the help of deep learning technology, natural language processing can quickly extract key information in information extraction; generate concise and clear abstract in automatic abstract; accurately identify speech commands in speech recognition and realize speech control; overcome language barriers in machine translation, realize real-time translation between multiple languages; gain insight into people's emotional tendency in emotion analysis, and provide strong support for decision-making.[20].

4.3 Expand the application of visual recognition

In face recognition, computer vision technology can accurately identify individual identities and be widely used in security monitoring; in target detection, this technology can monitor and locate target objects in the video in real-time. In image segmentation, computer vision technology can fine image and extract the area of interest. These technologies provide strong support for security, autonomous driving, and other fields[21].

4.4 Help with production and living

As the masters of artificial intelligence technology, intelligent robots show strong capabilities in perception, decision-making, and execution. In industrial production, intelligent robots can replace manpower to complete repetitive and heavy labor and improve production efficiency; in medical care, intelligent robots can assist medical staff in surgical operations, patient care, and other work. Intelligent robots are gradually replacing manpower, improving production efficiency and quality of life [22][23][24][25][26].

4.5 Promote the development of automation

technology

In the field of smart homes, intelligent control technology can realize automatic management of home equipment and improve the living experience; in modern agriculture, intelligent control technology can accurately adjust crop growth environment and improve yield and quality; and in industrial manufacturing, intelligent control technology can optimize the production process and reduce energy consumption and cost. These applications not only improve productivity but also reduce the risk of human error[27][28].

In addition, the application fields and technological breakthroughs of AI are continuing to expand and deepen, involving autonomous driving and intelligent transportation, smart medical care, fintech, education, and entertainment and creative industries.

5. The future outlook of artificial intelligence

Many traditional occupations are subject to the impact of artificial intelligence, and those with more mechanical behavior will be replaced first. While artificial intelligence has replaced some industries, it has also spawned some new industries [29]. The future development of artificial intelligence will pay more attention to the deep integration with human society. On the one hand, AI will realize intelligent applications in more fields, such as smart medical treatment, curriculum development, communication technology, health management, car driving, virtual city, etc.; on the other hand, AI will pay more attention to the cooperation with human beings, improve the efficiency of human-computer interaction and natural [30].

However, the development of artificial intelligence also faces many challenges. How can we ensure the security and control of AI technology? How can we balance the development of AI technology with the protection of human privacy? How can we avoid the abuse of AI technology and other problems that we need to think deeply about and solve?

6. Conclusion

As one of the hot spots in the field of science and technology, artificial intelligence has made remarkable progress and had a wide impact in various fields. In the future, with the continuous progress of technology and the continuous expansion of application scenarios, artificial intelligence will realize intelligent applications in more fields and bring more benefits to human society. At the same time, we also need to pay attention to and solve the challenges and problems in the development process of AI technology to ensure the healthy and sustainable development of AI technology.

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