Development Trends of Mathematics and Artificial Intelligence

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Abstract. This work primarily explores using mathematics in artificial intelligence and the direction of future growth. First, it goes over the background of mathematics and artificial intelli-gence; then, it emphasizes mathematics's vital role in supporting artificial intelligence. It then emphasizes how mathematics, particularly probability theory, linear algebra, calculus, and other disciplines, conceptually underpin artificial intelligence technologies, including machine learning and deep learning. Later, this study examines critical applications of mathematics in modern artificial intelligence, including mathematical frameworks in gen-erative models and applications in quantum computing. Finally, this work highlights the application of new mathematical disciplines, such as topology and complex systems, and anticipates the future development trend of mathematics and artificial intelligence. Simul-taneously, artificial intelligence's ongoing advancement could raise ethical concerns. This work attempts to underline the relevance of mathematics to artificial intelligence and to sort out the future development tendencies of mathematics and artificial intelligence so that they could better serve human beings.

Keywords: Mathematics; Artificial Intelligence; Complex systems; Application.

1. Introduction

Mathematics is a broad discipline intersecting artificial intelligence, and its profound theories and exquisite algorithms play a pivotal role in many fields of artificial intelligence. In our daily contact with or personally experienced artificial intelligence application scenarios, almost all can see the presence of mathematics; they are like an invisible link connecting the underlying logic of technology and our daily lives.

For example, when we browse an e-commerce platform, the home page often intelligently recommends products that appeal to us based on our browsing history and purchasing preferences. Behind this function is the application of matrix theory in mathematics, especially the similarity measurement technology in the matrix, which calculates the correlation between goods by analyzing user behavior data to achieve accurate push. It not only dramatically improves the user experience but also promotes the sales efficiency of the e-commerce platform.

For example, facial recognition technology has become standard in unlocking a smartphone or making online payments. This seemingly simple action relies on complex mathematical principles, especially feature extraction and matching techniques in matrix operations. The system can efficiently and accurately identify the user's face information by constructing the face feature matrix to ensure a safe and convenient operating experience.

In addition, in the field of travel, when taxi-hailing software uses artificial intelligence for route planning, it is also inseparable from the support of operations research. Optimization algorithms in operations research, such as the shortest path algorithm and dynamic programming, are widely used in route search and cost optimization to help passengers find the best travel plan quickly and provide drivers with efficient order-receiving strategies to realize reasonable allocation of resources.

For another example, in the in-depth exploration of the medical field, medical image recognition technology has become a revolutionary progress. This technology is deeply rooted in the fertile soil of artificial intelligence. With its powerful data processing and analysis capabilities, it has successfully analyzed and processed complex and changeable medical image data and delicate surgical procedures. It covers multiple dimensions, from basic 3D image modeling to high-precision tumor image recognition and even intelligent diagnosis of complex conditions, significantly improving the accuracy and efficiency of medical diagnosis.

This technical achievement is not accidental; it is behind the deep mathematical theoretical knowledge in the silent support. Specifically, the core mathematical principle of medical image recognition technology is matrix-based. By converting medical image data into a series of specific matrix data, scientists can efficiently identify and accurately analyze medical images using sophisticated matrix computing techniques. This process shows the infinite possibilities of the intersection of mathematics and medicine and profoundly reveals the vital position of mathematics as the cornerstone of artificial intelligence.

At present, this technology has aroused wide attention and heated discussion in both academia and industry. More and more scholars, engineers, and industry experts have begun to focus their research on the intersection of mathematics, artificial intelligence, and specific industry applications, exploring how to promote the intelligent transformation and upgrading of more industries through the optimization of mathematical models and the innovation of artificial intelligence algorithms. Facts have repeatedly proved that mathematics is not only the cornerstone of the development of artificial intelligence, providing a solid theoretical basis for the construction and optimization of algorithms, but at the same time, the rapid development of artificial intelligence technology has extensively promoted the overall progress of human society, from medical diagnosis to intelligent manufacturing, from smart cities to intelligent transportation, artificial intelligence is changing our lives with unprecedented power. And all this is inseparable from the silent support of this powerful mathematics tool.

These application examples of artificial intelligence not only immensely enrich our lives and improve our quality of life but also more profoundly demonstrate the indispensability of mathematics in artificial intelligence. From basic algorithm design to complex system construction, mathematics is an important engine driving the advancement of artificial intelligence technology. With the continuous development of technology, the combination of mathematics and artificial intelligence will be more closely, jointly opening the infinite possibilities of the intelligent era.

2. Research review

2.1 Research objectives

The purpose of this study is to systematically explore the critical role and application trend of mathematics in the development of artificial intelligence. First, we will analyze the fundamental contributions of mathematical theories, including linear algebra and probability theory, in artificial intelligence. Secondly, this study will focus on the application trend of mathematics in artificial intelligence and explore its prospects for solving complex problems. Finally, through an in-depth analysis of the intersection of mathematics and AI, this paper hopes to provide theoretical support for future research and practical guidance for scholars and engineers in related fields to promote the further integration and application of mathematical tools in artificial intelligence innovation(Zhang, 2020).

2.2 Research significance

The rapid development of artificial intelligence technology increasingly relies on the support of mathematical tools and theories. The research significance of this paper is reflected in the following aspects: First, through an in-depth analysis of the relationship between mathematics and artificial intelligence, the core position of mathematics in AI algorithm design, model optimization, and data processing is clarified. Second, this research will promote the exploration of the integration of emerging mathematical methods with traditional AI technologies, promote interdisciplinary cooperation, and provide innovative ideas for solving complex practical problems. In addition, as the field of AI applications expands, understanding the mathematics behind it will help improve the transparency and interpretability of models, which is critical to ensuring the fairness and reliability of AI systems. Finally, by summarizing the current development trend, this paper hopes to point out the direction for future research and provide a theoretical basis for application practice to enhance the importance and application effect of mathematics in artificial intelligence(Thunki et al., 2021).

2.3 Research work

When conducting a literature search, I first searched the university library's database for books and journal articles related to mathematics and artificial intelligence. In addition, I use online academic search engines such as Google Scholar and ResearchGate to get the latest published articles. When determining the direction of the thesis, I chose the combination of mathematics and artificial intelligence according to my interest in interdisciplinary research, especially to explore the application of mathematics in artificial intelligence.

To find the information and resources I need, I use keyword search strategies, including "Application of mathematics in artificial intelligence," "Mathematical principles in Deep Learning," and "machine learning algorithm design." Along the way, I constantly tweak the keyword mix to ensure the broadest possible coverage of the literature. In addition, referring to previous research results and citations has also become part of my information collection, helping me to build a comprehensive understanding of the field.

When reading the literature, I developed a clear query framework, first identifying the core theories and applications related to my research objectives. When looking for literature that meets the requirements, I pay special attention to research methods, mathematical tools used, and application scenarios. This approach allows me to identify high-quality, well-targeted papers and extract critical information, ensuring my research content is reliable and authoritative.

Finally, through the comprehensive reading and analysis of the literature, I made clear the paper's goal, focusing on the core role of mathematics in artificial intelligence algorithms and the potential direction of future research. It enriched my academic vision and laid a solid foundation for my research.

3. Discussion

3.1 Linear algebra

A matrix is a two-dimensional array of m rows and n columns of elements, widely used in linear algebra and data analysis(Sen& Das, 2023). A vector is a one-dimensional array with direction and size, regarded as a matrix of specific dimensions. It is an essential tool for describing the position and change of points in space(Zhao et al., 2020).

In linear classifiers such as support vector machines (SVM), linear algebra defines decision boundaries and achieves maximum interval classification by the Lagrange multiplier method(Pisner & Schnyer, 2020). In deep learning, both forward propagation and backpropagation of neural networks rely on matrix multiplication and chain rule. The weight matrix updating uses gradient information to make the model converge to the optimal state step by step. Linear algebra also plays a vital role in dimensionality reduction techniques. For example, principal component analysis (PCA) uses eigenvalue decomposition to project high-dimensional data into a low-dimensional space(Kherif & Latypova, 2020), thereby preserving information about the significant variations in the data(Howley & Madden, 2005). These applications show that linear algebra provides theoretical support for machine learning, lays a solid foundation for algorithm design and implementation, and promotes the continuous development of artificial intelligence.

Table 1. Basic information about linear algebra

Linear Algebra Concept	Description	Machine Learning Application	References

Matrix	A two-dimensional array composed of m rows and n columns.	Dataset representation, batch computation, and analysis.	Sen & Das (2023)
Vector	A one-dimensional array with direction and magnitude.	Feature vector construction, sample representation.	Zhao et al (2020)
Vector Operations	Operations between vectors such as addition, subtraction, etc.	Feature vector construction during the data preprocessing stage.	Strang (2022)
Decision Boundary	A boundary is used to separate different classes.	Support Vector Machines (SVMs) and other linear classifiers.	Pisner & Schnyer (2020)
Lagrange Multipliers	A method in optimization problems.	Achieving maximum margin classification.	Pisner & Schnyer (2020)
Matrix Multiplication	The multiplication operation between two matrices.	Forward propagation in neural networks.	Aggarwal et al (2020)
Chain Rule	A method for computing the derivative of a composite function.	Backpropagation in neural networks.	Aggarwal et al (2020)
Weight Update	Adjusting weights using gradient information.	Optimization during the model training process.	Aggarwal et al (2020)
Eigenvalue Decomposition	The decomposition of a matrix into eigenvalues and eigenvectors.	Dimensionality reduction in Principal Component Analysis (PCA).	Kherif & Latypova (2020)
Low-Dimensional Projection	Mapping data from a high-dimensional space to a lower-dimensional space.	Preserving significant variance information.	Howley & Madden (2005

3.2 Probability theory and statistics algebra

A probability distribution is a familiar concept often used to describe the likelihood of different outcomes for random variables, which can be expressed as a mathematical function(Makar & Rubin, 2020). Probability distributions are widely used in machine learning and artificial intelligence, often for information modeling(Rahman et al., 2020). We have looked at many average circulations, such as the normal circulation and the Poisson flow, and these circulations are the basis for many models. Various statistical reasoning techniques have been proposed for the probability distribution, such as criterion estimate, hypothesis screening, etc. Many researchers can use these methods to make models, enhance precision and dependability, and supply assistance for decision-making.

An essential statistical principle, bayesian networks(Mihaljević et al., 2021) are frequently used to make inferences and assistance decisions. Bayesian networks are directed acyclic graphs that might have lots of nodes, each representing a random variable and each linked edge representing a conditional reliance between them. We can review the probability distribution, look at the information, and use this model algorithm to infer unidentified variables. Bayesian networks have been used in medical and fault detection, achieving excellent outcomes.

3.3 Calculus

In artificial intelligence, optimization is a crucial method for enhancing target functions in the design. The best approach is widely used in model education and parametric solutions. The most important is reducing the heel, which allows us to update the parameters and minimize the loss of functions as much as possible(Mustapha et al., 2020). Given the target function's inclination change, several motion methods determine the minimum inclination near the region or the general level(Sun, 2020). This computational method is effective, understandable, and the leading technology in academic and industrial circles(Pinaya et al., 2020).

Autoencoders are an unsupervised learning framework whose core mission is to compress input data into efficient and informative feature representations. Singular value decomposition (SVD) plays a vital role in data dimensionality reduction and analysis, which can extract critical features and reduce noise, thus significantly improving the model's overall performance (Scarselli et al., 2008).

GNN models complex relationships and structured data based on graph theory. It captures the intrinsic topological information of data by accurately describing the connection between nodes and edges, so it shows great application value in social network analysis, recommendation systems, and other practical application scenarios. The convergence of these mathematical techniques has extensively promoted the development of deep learning models that can address and solve complex real-world challenges.

3.4 Contribution of mathematics to neural networks

The backpropagation algorithm is the fundamental mechanism of neural network training (Rojas & Rojas, 1996). This procedure aims to decrease forecast errors through criterion optimization while improving the model's generalization capability. Furthermore, introducing automatic differentiation innovations has dramatically improved the performance and accuracy of derivative calculations, making the training of deep learning designs more effective and with excellent scalability.

In artificial neural networks, the activation function is essential to each neuron's role; it is responsible for mapping the input signal to the output and is vital in helping the network acknowledge complicated patterns in information (Gai & Zhang, 2021). This nonlinear conversion process defines how nerve cells transform input information into output reactions.

In deep learning, the importance of activation functions is obvious; They give neural networks the ability to capture complex nonlinear relationships, allowing the network to replicate complex functions or mapping relationships more accurately. In neural network architectures, activation functions play a crucial role by introducing nonlinear nonlinear relationships that enable designs to discover complex mapping relationships between inputs and outputs. (Goodfellow et al., 2020).

Typical activation functions include Sigmoid, ReLU, and Tanh. The Sigmoid function is extensively utilized in binary category tasks, which can compress input values from 0 to 1. However, the challenge of a vanishing gradient exists. On the other hand, ReLU functions are favored in deep knowing because of their simplicity and rapid convergence, although they sometimes result in issues with "neuronal deactivation." The output worth of the Tanh function changes between -1 and 1, efficiently enhancing the gradient propagation performance in the training process.

Table 2. The Role of Mathematics in Artificial Intelligence: An Overview

Mathematical Field	Description	Application in AI	Examples
Linear Algebra	A branch of mathematics that studies vector spaces (including matrix theory) and linear mappings.	Data representation, feature extraction, foundation for machine learning algorithms.	Construction of feature vectors, the definition of decision boundaries in SVMs, and weight updates in neural networks.

Probability & Statistics	The mathematical theory deals with random phenomena, including data collection, analysis, interpretation, and presentation.	Modeling uncertainty, probabilistic inference, model evaluation, Bayesian methods.	Bayesian networks, Hidden Markov Models, Gaussian Mixture Models.
Calculus	Mathematical tools for studying rates of change and accumulations.	Optimization problems, gradient descent, backpropagation algorithm.	Gradient computation, minimization of loss functions.
Information Theory	The mathematical theory of quantifying, storing, and communicating information.	Coding and compression, concept of entropy, mutual information.	Data compression techniques, feature selection.
Graph Theory	A branch of mathematics that studies graph structures and their properties.	Social network analysis, recommendation systems, and pathfinding algorithms.	PageRank algorithm, community detection in social networks.
Optimization	Finding the best solution can be maximizing or minimizing an objective function.	Parameter tuning, hyperparameter search, policy improvement in reinforcement learning.	Margin maximization in support vector machines, training of neural networks.
Function Approximation	Techniques for approximating complex functions using more straightforward functions.	Nonlinear regression, choice of activation functions in neural networks.	Kernel methods, Radial Basis Function Networks.

3.5 Mathematical framework in the generation model

Deep learning encompasses many architectures, among which Generative Adversarial networks (GANs) based on game theory are special. The GAN architecture consists of two contending networks: the generator and the discriminator. The generator is responsible for creating samples that highly resemble the accurate information. At the same time, the discriminator is accountable for recognizing the differences between the actual sample and the produced sample. This competition between the two forms a game in which the generator aims to increase the probability that the fake sample it generates will be mistaken for the real one. In contrast, the discriminator seeks to reduce this error rate.

The core objective of GAN is to enhance the loss function between the generator and the discriminator. In the training process, this competition mechanism prompts the two networks to update the parameters iteratively. With the deepening of training, the two networks continue to optimize, making the generated samples more and more realistic. The success of GANs lies in the fact that game theory provides a solid theoretical foundation for its dynamic interaction, which makes the model show broad application potential in many practical fields, such as image recognition and data enhancement.

This section will introduce a new mathematical model for artificial intelligence, variational autoencoders (VAE). This model is deeply rooted in the widely known Bayesian theory, and its principle is clear and understandable. The model skillfully uses variational reasoning techniques to reveal the posterior distribution of potential variables step by step. The difference from previous methods is that VAE simulates and generates sample data by introducing random elements(Doersch, 2016).

In this model, the core goal is to maximize the edge likelihood of the observed data, but this is undoubtedly a difficult task. To address this challenge, we introduce a learnable distribution that is as close to the actual case as possible by minimizing the KL divergence. Then, by optimizing the lower bound, the efficient reconstruction of the data is realized, which lays a solid foundation for the broad application of the model, especially in natural language processing and speech recognition. When dealing with uncertain data, the VAE model shows its unique advantages.

Quantum computing and artificial intelligence

Quantum machine learning, an advanced field of artificial intelligence, may seem unfamiliar to many. It cleverly blends the strengths of quantum computing and machine learning, aiming to achieve deep optimization of algorithms such as neural networks through the synergy of the two. In this fusion process, many mathematical theories play a crucial role, such as linear algebra, complex analysis, and probability theory, which together provide potent tools for describing and manipulating quantum states(Martín-Guerrero & Lamata, 2022).

Qubit coding has become an innovative method of expressing information in quantum computing, and linear combinations of complex vectors describe quantum states. This property gives quantum computers the extraordinary ability to process data in parallel in complex, high-dimensional Spaces, leading to unprecedented leaps in performance.

With its unique advantages, the quantum machine learning algorithm optimizes the efficiency of parameters, significantly improves the accuracy of data classification, and dramatically speeds up the algorithm's calculation speed. Exploring this field has undoubtedly pioneered a path to developing artificial intelligence.

This unique mathematical framework promotes the advancement of machine learning technology. It provides new ways to solve the challenges in large-scale data analysis, thus establishing quantum machine learning's central position in the development of artificial intelligence.

3.6 Application of emerging mathematical theories in AI

Topology is a branch of mathematics that studies the properties and transformations of space. It is significant for data analysis, especially for high-dimensional data processing. With the rapid development of big data and machine learning, applying topological concepts and tools in data analysis has gradually shown its unique advantages.

One primary application is persistent homology, which studies topological features by extracting shape information from data. This method can identify structural patterns and local features in the data set, especially in the presence of noise. Persistent homology has been widely used in biological data analysis, image processing, and social network analysis(Edelsbrunner & Harer, 2008).

In the future, topology will be combined with other areas of mathematics, such as statistics and optimization theory, to drive the development of new algorithms and designs. In addition, with improved calculating power, topological data analysis may show greater capacity in real-time data circulation processing and complicated system modeling. These trends recommend that geography will play a progressively important role in information science, helping to fix more complex problems and potentially leading a new revolution in information analytics(Sierpinski, 2020).

In machine learning design building and optimization, symbolic computation can offer precise gradient and Jacobian matrix(Meng et al., 2023), which helps to optimize the performance and accuracy of model training. In addition, applying mathematical and symbolic computation in analytical service solving, symbolic regression, and feature extraction offers theoretical support for complex system modeling. Second, combined with natural language processing (NLP), symbolic computing can improve the model's ability to understand and solve mathematical problems, making AI more practical in education, scientific research, and other fields. For example, systems based on symbolic computing can automatically generate mathematical proofs or solve advanced mathematical problems, assisting researchers and students(Yi & Li, 2024).

In the future, with the continuous improvement of computing resources, mathematical and symbolic computation algorithms will be more efficient, and this is expected to promote more innovative applications in AI, especially in complex tasks such as scientific discovery, engineering design, and financial analysis.

As the core branch of complex system behavior exploration, nonlinear dynamics has shown great application potential in the intersection of mathematics and artificial intelligence(Nelles & Nelles, 2020). Because of its inherent nonlinear characteristics, it is difficult for traditional linear models to describe complex systems' behavior accurately. Therefore, a deep understanding of these nonlinear properties is essential for predicting and controlling the behavior of complex systems(Siegenfeld & Bar-Yam, 2020). In artificial intelligence, intense learning, machine learning algorithms, with their powerful data-driven learning capabilities, can accurately capture nonlinear relationships in complex systems. The ability of neural networks to imitate complicated nonlinear functions with their multi-layered structure has allowed deep finding out to achieve exceptional leads in fields as varied as environment modeling, monetary market analysis, and biological systems(Yang & Wang, 2020). At the same time, integrating the theoretical structure of nonlinear characteristics improves the design's interpretability and assists researchers in accurately identifying and identifying variables and interactions in the system. As calculating power and algorithmic technology continue to advance, the integration of nonlinear dynamics and artificial intelligence will be deepened, substantially enhancing the flexibility and toughness of intelligent systems and supplying more accurate services for complex environments such as social networks, communities, and engineering applications.

Over the last few years, many scholars have promoted the integration of mathematical optimization algorithms into the style of artificial intelligence systems. The gradient descent method and its related neural network algorithm are particularly eye-catching in this research field and become a new research focus. The core of these algorithms is to minimize the loss function and improve the model performance through iterative updating strategies. In addition, optimization methods such as adaptive learning rate, second-order optimization approach, and evolutionary strategy constantly evolve and enhance, playing an essential role in improving design efficiency.

With the increasing intricacy of the natural world, the difficulty and dimension of optimization issues are likewise increasing, motivating researchers to explore more efficient algorithms continuously. This exploration process has resulted in brand-new mathematical optimization algorithms, which are once again applied to resolve real-world problems such as transport, energy optimization, and resource allotment. Applying mathematical models to the design of artificial intelligence systems, as a necessary pattern of the cross-integration of mathematics and artificial intelligence, can offer strong support for decision-making and lay a solid structure for enhancing the system's versatility.

In light of this, academia and industry are actively exploring explainable AI pathways, aiming to simplify complex models with tools that improve public understanding. In this process, linear regression, decision trees, and other simple models play a crucial role, which helps reveal the internal logic of the model and enhance its interpretability.

At the same time, fairness is also a big challenge in the development of AI. Many machine learning models may unfairly affect certain groups due to data reading bias, group selection bias, and other issues. To this end, researchers have innovatively proposed strategies such as fair constraint optimization to ensure that all users enjoy equal decision-making criteria. Strategies to prevent and correct bias must be integrated into the entire model-building and evaluation process.

Improving the transparency and fairness of mathematical models is a long-term task that involves overcoming technical difficulties and discussing ethical and social issues. Promoting interdisciplinary exchanges and cooperation will be the key to achieving this goal and building excellent AI systems in the future.

Table 3. Future Research Directions in Mathematics and Artificial Intelligence

Research Direction	Main Applications	Expected Impact
Application of Topology in AI	Persistent homology for biological data analysis, image processing, and social network analysis.	Development of new algorithms, real-time data stream processing, and complex system modeling.
Symbolic Computation and Machine Learning Integration	Precise gradient and Jacobian matrix for model training; support for complex system modeling; enhanced NLP for mathematical problem-solving.	Improved model training performance and accuracy; assistance in education and research; automatic generation of mathematical proofs.
Nonlinear Dynamics and AI Fusion	Capturing nonlinear relationships in complex systems, environmental modeling, financial market analysis, and biological systems.	Increased flexibility of intelligent systems; more accurate services for complex environments (e.g., social networks, communities, and engineering applications).
Integration of Mathematical Optimization Algorithms in AI Design	Minimizing loss functions through iterative update strategies, improving model efficiency.	Solving real-world problems (e.g., transportation, energy optimization, and resource allocation); strong support for decision-making.
Enhancing Transparency and Fairness of AI Models	Using simple models to explain internal logic, ensuring equal decision criteria for all users.	Building public trust, preventing and correcting bias, and promoting interdisciplinary exchanges and collaboration.

4. Conclusion

This paper systematically introduces the primary function, practical application, and future development trends of mathematics in artificial intelligence. First of all, the theoretical basis of mathematics provides a great help to artificial intelligence technology, and mathematics is the core of artificial intelligence algorithms. In addition, mathematics has many innovative and cutting-edge applications in the field of artificial intelligence, which has significant influence and potential to promote the progress of artificial intelligence in the future. In the future, we should focus more on the cross combination of mathematics and artificial intelligence; on the one hand, is the emerging mathematical theory, and the other is the continuous emergence of artificial intelligence needs and realization, the need for mathematics and artificial intelligence to achieve an organic combination to serve people's lives better. With the increase in the amount of data and the refinement and difficulty of people's needs, the role of mathematics in algorithm optimization has become increasingly apparent. We can better serve society and the country through interdisciplinary, cross-integration, and deepening cooperation. As the foundation of artificial intelligence algorithms, mathematics is crucial in basic logic and model optimization. Through algorithm design, model construction, data analysis, optimization, and improvement, mathematics has dramatically improved artificial intelligence models' usability, practicability, and reliability. In the future, the importance of mathematics will only increase, driving technological innovation and upgrading.

5. Evaluation

Before the project began, I had a preliminary understanding of mathematics and artificial intelligence. However, the relationship and future development trends must be more precise and accurate. While doing this project, I consulted relevant literature to clarify the relationship between some common theories in mathematics and artificial intelligence algorithms and understand the industry's current hot spots and cutting-edge research directions. Reading this literature made me think more in-depth, improved my logical thinking ability, and gained a deeper understanding of some practical applications. For example, when I commute to work and see cars on the road, I cannot help but think about the application of operations research in mathematics. When the face is recognized, I will think of the mathematical algorithm in image recognition. When I hear the voice of my little assistant, I think about natural language processing. I found no math or artificial intelligence, which gave me many new perspectives on life.

On the other hand, there is much research on large models, and the widespread application of ChatGPT makes people fully aware that the era of artificial intelligence has arrived. After reviewing the whole project process, I noticed that the most significant shortcoming was that the length needed to be reasonable. I want to introduce much content, but the article's length could be better, so I should use concise language to explain as much as possible. I still need to improve in this aspect. I will read more relevant literature and improve my mastery of the language.

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