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Method and Application of Analyzing Multi-class Data by Artificial Intelligence Model Group Based on Machine Learning

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ABSTRACT: As science and technology continue to advance in China, significant strides have been made in the realm of artificial intelligence [1]. This field, which intersects computer science, information science, and mathematics, primarily focuses on the development of intelligent technologies through computer systems. This paper begins by examining the fundamental concepts of artificial intelligence and machine learning, followed by an exploration of the factors influencing machine learning and the methodologies for its construction based on artificial intelligence technologies [2]. The aim is to broaden our perspective on the advancement of artificial intelligence in China and to contribute to the research of machine learning within the country, thereby enhancing its role in supporting China's economic growth [3]. To fully leverage the potential of artificial intelligence, it is essential to investigate the intrinsic meanings, research objectives, and methodologies associated with machine learning [4]. Utilizing big data technology, this paper analyzes the precise evaluation of educational data across various regions, addresses the challenges of integrating artificial intelligence into the educational framework, and highlights how machine learning caters to the educational needs of individuals during modernization. Additionally, it discusses the fundamental concepts and applications of machine learning to foster the progress of artificial intelligence technology [5].

I. INTRODUCTION

With the emergence of the big data era and advancements in computer technology, artificial intelligence has transitioned from a reliance on expert systems to being primarily driven by algorithms. Machine learning represents a significant branch within this algorithmic framework. It is integrated into artificial intelligence software as a "model," and the effectiveness of this "model" plays a crucial role in determining the overall success of artificial intelligence applications. Assessing machine learning models is vital for ensuring the quality of both the "models" and the artificial intelligence they support. Although there has been some exploration into the performance and stability of machine learning models, a comprehensive evaluation index system remains undeveloped, revealing a notable deficiency in assessing model robustness. The field of artificial intelligence encompasses a broad spectrum of disciplines, including computer science, information science, mathematical science, engineering technology, and philosophical psychology, among others. The primary focus of research in this area is to equip machines with fundamental capabilities for learning, communication, input, and output. The ultimate aim is to enable machines to possess an understanding of the world and the capacity for independent thought. Artificial intelligence enhances machine intelligence, which is essential for achieving intelligent performance in computers. The core objective of this research is to endow machines with the abilities to learn, communicate, input, and output, as well as to foster independent thinking akin to that of humans, along with the capacity to comprehend and perceive their environment. In the context of artificial intelligence technology, addressing the challenge of realizing machine learning is a critical issue for global development. In the study of artificial intelligence, the primary objective is to align machine operations with human thought processes, to understand the world through a human lens, and to utilize human reasoning, ultimately enabling machines to emulate human thinking.

II. MACHINE LEARNING KNOWLEDGE SYSTEM

1. Integration of Machine Learning Data-Driven Mechanisms and Models

When the relationship between inputs and outputs is either unknown or overly complex, the traditional deterministic approach may prove inadequate. In such instances, provided there is a sufficient amount of data and corresponding labels, a novel mapping relationship can be established, leading to the formation of a new research paradigm through data-driven machine learning. This newly defined mapping relationship is represented by a neural network model that is trained using the available data and its labeling system. The process encompasses the creation of training and test sets, the development of the neural network model, the establishment of evaluation criteria and methods, and a comprehensive iterative learning process. The resulting trained neural network model serves as the new mapping relationship, facilitating the transition from input to output. The fundamental principle of this network model is relatively straightforward, consisting of a series of linear operations combined with nonlinear activation functions. Machine learning primarily pertains to enhancing the learning capabilities of machines through the identification of systems or knowledge, enabling them to acquire new skills or insights. Much like human learning, if systematic learning is not undertaken or if the appropriate learning methodologies are not mastered, the effectiveness of machine learning can be significantly diminished, making it challenging to generate new knowledge and innovations. This principle holds true for machine learning as well; only by learning to analyze and address problems can we cultivate innovative capabilities. Machine learning represents a prominent area of research within the realm of artificial intelligence development. In essence, the objective of this research is to empower machines to acquire new knowledge, develop problem-solving abilities, establish relevant knowledge frameworks, and apply these competencies to real-world challenges. Machine learning serves as a pathway to achieving artificial intelligence, relying on algorithms and data to construct models that can describe existing data or forecast new data. In situations where the issue entails a substantial volume of data and there are either no established processing rules or the existing rules are overly complex, machine learning techniques may be employed. Examples of such techniques include facial recognition, speech recognition, detection of fraudulent transactions, and analysis of shopping trends. Machine learning technologies can be categorized based on their learning methodologies into supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning. This paper specifically examines the evaluation of supervised learning models

Machines exhibit a distinct form of adaptability to their environments, which differs significantly from that of human beings. Consequently, the study of how machines adjust to their surroundings has emerged as a critical area of focus within artificial intelligence research. The quality of the environmental data provided plays a crucial role in influencing the effectiveness of machine learning. Furthermore, the internal storage mechanisms of machines are often designed based on principles of environmental adaptability. However, the external environment tends to be intricate and multifaceted. To facilitate the learning process, a substantial volume of data is required, necessitating the elimination of redundant connections. This information should be synthesized and disseminated, establishing a foundational guideline for the system's operational directives. Such complexity in the machine learning process may hinder the long-term advancement of the overall system. The approach to machine learning involves integrating machine capabilities with human learning methodologies, thereby enhancing the effectiveness of learning strategies. By building upon human cognitive and learning frameworks, it is possible to amplify machine performance, showcasing attributes such as speed, extensive memory, and high reproducibility, ultimately leading to a more efficient machine learning paradigm. Currently, it is evident that there are two primary methodologies in machine learning. The first is the deductive learning system, which progresses from general principles to specific applications, allowing for conclusions to be drawn through axiomatic reasoning. The second is the inductive learning system, which operates in the opposite direction, transitioning from specific instances to broader generalizations

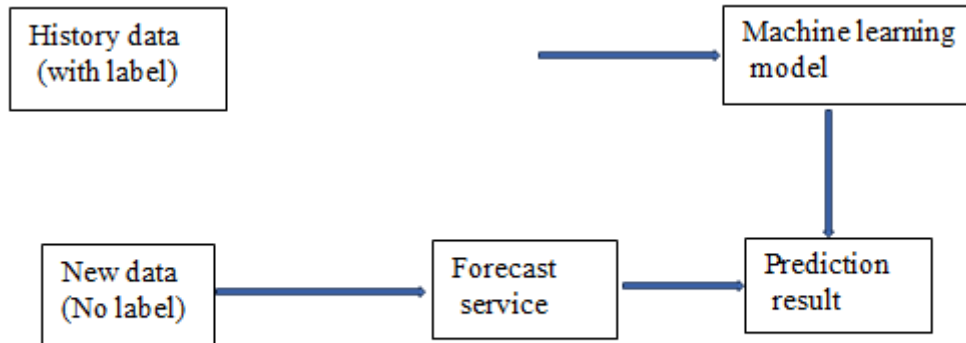


Figure 1: A diagrammatic representation of supervised learning.

2. Investigation into Environmentally Adaptive Machine Learning

The typical workflow of a machine learning project encompasses several stages: defining the problem, gathering data, processing the data, conducting feature engineering, establishing the model, applying the model, and monitoring its performance. This workflow is inherently cyclical and iterative, as illustrated in Figure 2.

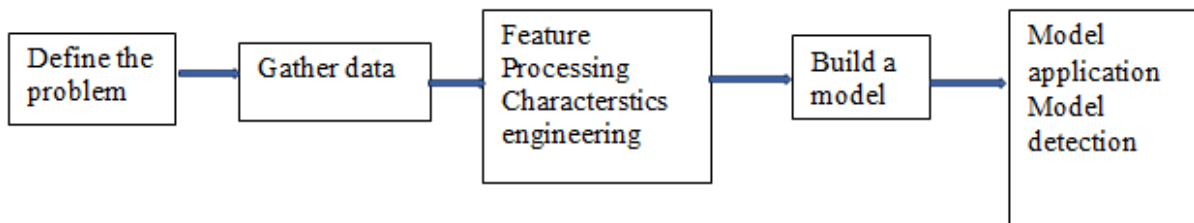


Figure 2 : Diagram illustrating the workflow of a machine learning project.

The pre-trained convolutional neural network (CNN) model is employed to classify and predict unlabeled images. The model calculates the probability of each sample belonging to various categories, which is subsequently normalized. The relevant formula is as follows:

$$f(z) = \sum_j e^{f_j}$$

The nearest neighbour entropy is defined as the difference between the highest probability and the second highest probability for an image sample as predicted by the classifier. This can be computed using the following formula:

$$S = f_{\text{max}} - f_{\text{max}-1}$$

This metric represents the ratio of correctly identified instances to the total number of instances. However, it is important to note that in cases of unbalanced data distribution, the presence of numerous categories can skew the accuracy calculation, making it unsuitable for scenarios where misclassification costs vary. The formula for accuracy is:

$$\text{accuracy} = \frac{\text{correct}}{\text{samples}}$$

The fundamental process of machine learning involves starting with a dataset, training a deep data network by minimizing the loss function, and then utilizing the trained deep neural network model to map input data, thereby

enabling predictive or cognitive functions. This learning methodology can be applied across various practical challenges and can be tailored to specific needs. The process can either focus on a specific intelligent aspect or be expanded further. In scenarios characterized by dynamic processes, newly generated data and labels can establish a comprehensive closed loop through ongoing iteration, optimization, and enhancement, thereby increasing the model's accuracy and adaptability. For instance, geophysical logging possesses a robust mechanistic model and a solid mathematical foundation, allowing for separate modeling and the development of distinct forward and inverse modeling theories and methodologies. However, challenges often arise when integrating two or more types of data from varying sources, scales, and modalities. Fortunately, with the advent of artificial intelligence, the fusion of multi-source, multi-scale, and multi-modal data has become manageable. This shift signifies a fundamental transformation and significant advancements in the data-driven research paradigm concerning the application of diverse geophysical data.

III. ENVIRONMENTAL ADAPTIVE MACHINE LEARNING ANALYSIS

1. An analysis of the extension of the machine knowledge base.

The configuration of a machine knowledge base plays a crucial role in the advancement of machine learning. It is essential to ensure that the knowledge base is comprehensive in its types and varied in its formats, encompassing fundamental feature vectors, regular language, and network associations, among others. Consequently, when designing the machine knowledge base, it is imperative to appropriately expand and enhance it to improve the machine's learning capabilities. Initially, a machine expression model characterized by straightforward logic and clear ideographic representation is necessary, with a reasoning process that is uncomplicated and easily comprehensible, thereby minimizing the computational burden. This necessitates that the machine learning system engages in a straightforward reasoning process, ultimately requiring a thorough expansion of knowledge and perception. The learning process of the machine system, within the context of artificial intelligence technology, demands not only a solid grasp of fundamental knowledge but also an enhancement of knowledge representation methods and efficiency in expression. The expression of knowledge necessitates various modes, and the requirements for constructing systems differ accordingly. Within the realm of machine learning, the development of a machine knowledge base holds significant importance. This knowledge base must ensure a variety of types and forms, incorporating elements such as regular language and network associations. Consequently, the design of the machine knowledge base should be adaptable to real-world conditions to enhance the machine's learning capabilities. The effectiveness of machine learning functions must be assessed through a feedback evaluation system, which encompasses several key components: (1) The feedback evaluation concerning the fundamental performance of machine learning is straightforward in its process and relatively basic in content. (2) The complexity feedback evaluation system is characterized by its diverse conceptual design. (3) In the strategic analysis and evaluation system, it is essential to establish the appropriate evaluative relationships prior to conducting effective assessments. The evaluation of these three components is not an instantaneous achievement; rather, it requires long-term measurement based on relevant data and tasks to effectively establish a feedback mechanism. The quality of software is comprised of various quality elements, each defined by specific measurement standards, which in turn consist of quantitative indicators. Barr YW. Boehm introduced a hierarchical model for software quality evaluation in the context of Software Risk Management. McCall et al. further dissected software quality into measurement levels, proposing a three-tier model that includes quality elements, measurement standards, and measurement indicators, as illustrated in Table 1.

Name	Describe	Content
Quality element layer	A set of quality attribute describing that characteristic point of software quality	Functionality, ease of use, reliability, Maintainability, portability, equal quality, characteristics and subcharacteristics produced by refining quality characteristics
Measurement standard layer	Combination of multiple measurement standards, each combination is used to measure a standard characteristic.	Accuracy, robustness, security, communication effectiveness, processing effectiveness, equipment effectiveness, operability, traceability, visibility, hardware system independence, software system independence, extensibility, commonality, modularity, clarity, selfdescription, simplicity, structure, file completeness, etc.
Metric index layer	Combination of multiple metrics, each combination is used to measure a metric.	Defined by each envoy. For example, in the stages of software requirement analysis, outline design, detailed design, coding, testing, confirmation maintenance and use, a questionnaire for selecting metrics is formulated in each stage to determine metrics.

TABLE 1: Evaluation of software quality using a three-layer fcm model.

2. System for evaluating feedback in machine learning.

The implementation of machine learning utilizing artificial intelligence technology necessitates the establishment of a corresponding feedback and evaluation system. This system should be developed incrementally, aligned with specific tasks related to machine learning feedback. Furthermore, it is essential to enhance the transparency of the learning feedback evaluation mechanism, ensuring that both the processes and outcomes of implementation are articulated clearly and succinctly. A thorough assessment of the existing knowledge base is required, and a meta-level expression should be employed in the feedback evaluation format. Such a feedback evaluation system will facilitate the integration of artificial intelligence technology in machine development, thereby broadening the scope of machine learning and enhancing its operational capabilities. The offline performance test of the MCI model is illustrated in Figure 3.

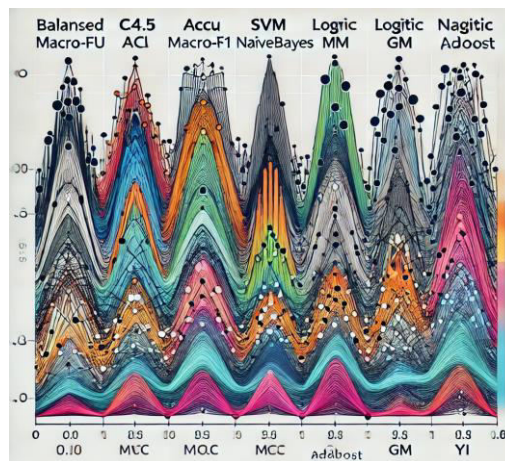


Figure 3: Performance evaluation of the 3MCI model conducted offline.

IV. CONCLUSION

The aforementioned research indicates that we are currently in the age of artificial intelligence, with machine learning emerging as a significant area of focus. This topic is pivotal across various disciplines, each examining it through the lens of its own advancements. It is essential to conduct a thorough analysis of the current state of machine learning and to delineate the research outcomes at each developmental stage. Key areas of focus include the formulation of artificial intelligence theories, the investigation of practical applications, the extension of artificial intelligence technologies into diverse fields, and the utilization of these technologies to facilitate profound social transformations and enhance the quality of life and productivity for individuals. Machine learning serves as a foundational technology in the evolution of artificial intelligence. To maximize the potential of artificial intelligence systems, it is crucial to continually advance research in machine learning. Consequently, attention must be directed towards the future trajectories of machine learning, alongside more comprehensive studies of its developmental prospects, to enable the extensive application of artificial intelligence across various sectors and to furnish robust technical support for societal advancement.

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