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Role of Mathematics in Artificial Intelligence

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ABSTRACT

Present research study are focused on role of Artificial Intelligence. The aim of this research paper is to conceptual background of Artificial Intelligence and also to study the subfield of Artificial Intelligence. My goal is to contribute to clarify the major role of mathematics in modern technology. Artificial Intelligence and Knowledge-Based Systems are the sub-areas include search technologies, knowledge representation, vision, natural language processing, robotics, machine learning, and others. A host of ideas and techniques from AI have the potential to impact the practice of mathematical modeling. Artificial Intelligence (AI) has emerged as a transformative technology, revolutionizing various aspects of our lives. Behind the remarkable advancements and capabilities of AI lies the foundational role of mathematics. Mathematics provides the framework that enables AI systems to learn, reason, and make intelligent decisions. In this article, we explore the application of mathematics in the field of AI and its significance.

KEYWORDS: Mathematics, Modern Technology, Computer Science, Artificial Intelligence

INTRODUCTION

Mathematics serves as the backbone of AI algorithms and models, empowering machines to process, analyze, and interpret vast amounts of data. Concepts from linear algebra, calculus, probability theory, and statistics are essential for developing machine learning algorithms. These algorithms use mathematical equations and functions to identify patterns, make predictions, and classify information.

Linear algebra, for instance, is fundamental in designing neural networks, which are the building blocks of deep learning. Matrices and vectors are used to represent and manipulate data within neural networks, facilitating complex computations and enabling AI systems to extract meaningful insights from data.

Calculus plays a crucial role in optimizing AI models. Techniques such as gradient descent and back propagation utilize calculus to minimize errors and adjust the parameters of machine learning models. These mathematical techniques enable AI systems to learn from data and continuously improve their performance.

Probability theory and statistics are vital in AI for tasks such as natural language processing, computer vision, and decision-making. Probability distributions, Bayesian inference, and hypothesis testing provide the mathematical framework to quantify uncertainty, analyze data, and make probabilistic predictions.

CONCEPTUAL BACKGROUND

Mathematics is a human activity involving the solution of problematic situations. In finding the responses or solutions to these external and internal problems, mathematical objects progressively emerge and evolve. According to Piagetian constructivist theories, people's acts must be considered the genetic source of mathematical conceptualization. Mathematical problems and their solutions are shared in specific institutions or collectives involved in studying such problems. Thus, mathematical objects are socially shared cultural entities. Mathematics is a symbolic language in which problem-situations and the solutions found are expressed. The systems of mathematical symbols have a communicative function and an instrumental role. Mathematics is a logically organized conceptual system. Once a mathematical object has been accepted as a part of this system, it can also be considered as a textual reality and a component of the global structure. It may be handled as a whole to create new mathematical objects, widening the range of mathematical tools and, at the same time, introducing new restrictions in mathematical work and language.

OBJECTIVES OF THE RESEARCH STUDY

The said research study was carried out with following objectives in view:-

1. To study the conceptual background of Artificial Intelligence.
2. To study the subfield of Artificial Intelligence.

RESEARCH METHODOLOGY

The collection of data for preparing the said research paper are based on secondary data. The Secondary Data is collected from various reference books related to Artificial Intelligence, Fundamentals of Computer Algorithms, Linear Algebra and Optimization for Machine Learning etc. For said research study secondary data is also collected from the National and International Research Journals which are related to Artificial Intelligence, Mathematics etc. For the present research study the data pertaining to the above objectives was collected and reviewed the literature on the topic concerned. The literature was thus collected by visiting various libraries. The secondary data is also collected from various websites.

HYPOTHESIS OF RESEARCH STUDY

The said research study was carried out with following major hypothesis :-

1. In recent time, computer science uses various maths logic and number theory to develop data structures and computer algorithms.

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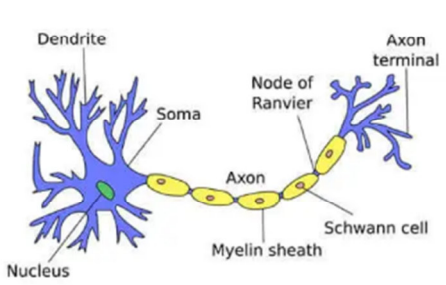
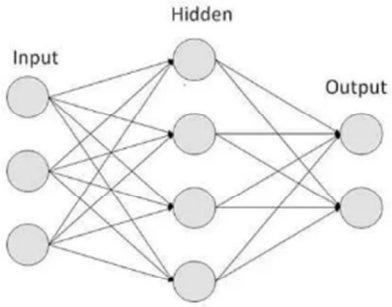
NEURAL NETWORK IN ARTIFICIAL INTELLIGENCE





Neural networks are a subset of AI, representing a specific architecture inspired by the human brain, while artificial intelligence is a broader field focused on creating intelligent systems that can perform tasks requiring human-like intelligence.

Neural networks, as the name suggests, involves a relationship between the nervous system and networks. It's a relationship loosely modeled on how the human brain functions. And it's used in many modern applications, including: driverless cars, object classification and detection, personalized recommendations, language translation, image tagging, and much more. A neural network is either a biological neural network, made up of real biological neurons, or an artificial neural network, designed to recognize patterns and solve business problems.

Artificial neural networks try to mimic the biological neural network in the human brain. Nature has inspired millions of innovations – everything from birds inspiring airplanes, burdocks inspiring velcro, to whales inspiring wind turbines to go faster. In the same way, the human brain has inspired the creation of neural networks. A typical brain contains close to 100 billion miniscule cells called neurons. Each neuron is made up of a cell body with a number of connections coming off it: numerous dendrites (the cell's inputs—carrying information toward the cell body) and a single axon (the cell's output—carrying information away). Dendrites extend from the neuron cell body and receive messages from other neurons. When neurons receive or send messages, they transmit electrical impulses along their axons that aid in carrying out functions such as storing memories, controlling muscles, and more.

There are areas, however, where the simplified model of the artificial neural network does not quite mimic the brain exactly. For example, it can't mimic the creation or destruction of connections (dendrites or axons) between neurons, and it ignores signal timing. Still, artificial neural networks are quite effective considering how they're used in many applications, and have become smarter over time.

MACHINE LEARNING IN ARTIFICIAL INTELLIGENCE

Machine learning is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behavior. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems.

When companies today deploy artificial intelligence programs, they are most likely using machine learning — so much so that the terms are often used interchangeably, and sometimes ambiguously. Machine learning is a subfield of artificial intelligence that gives computers the ability to learn without explicitly being programmed. Machine learning starts with data — numbers, photos, or text, like bank transactions, pictures of people or even bakery items, repair records, time series data from sensors, or sales reports. The data is gathered and prepared to be used as training data, or the information the machine learning model will be trained on. The more data, the better the program.

There are three subcategories of machine learning:

1. **Supervised** machine learning models are trained with labeled data sets, which allow the models to learn and grow more accurate over time. For example, an algorithm would be trained with pictures of dogs and other things, all labeled by humans, and the machine would learn ways to identify pictures of dogs on its own. Supervised machine learning is the most common type used today.
2. In **unsupervised** machine learning, a program looks for patterns in unlabeled data. Unsupervised machine learning can find patterns or trends that people aren't explicitly looking for. For example, an unsupervised machine learning program could look through online sales data and identify different types of clients making purchases.
3. **Reinforcement** machine learning trains machines through trial and error to take the best action by establishing a reward system. Reinforcement learning can train models to play games or train autonomous vehicles to drive by telling the machine when it made the right decisions, which helps it learn over time what actions it should take.

CONCLUSION

In this research paper, I studied the Neural Network and machine learning in Artificial Intelligence. A neural network is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain. It is a type of machine learning process, called deep learning that uses interconnected nodes or neurons in a layered structure that resembles the human brain. The application of mathematics in AI is fundamental to the development and success of intelligent systems. Mathematics provides the tools and concepts necessary for AI algorithms to process data, learn patterns, and make informed decisions. As AI continues to evolve and shape our world, the synergy between mathematics and AI will remain crucial, unlocking new frontiers and possibilities for innovation. By harnessing the power of mathematics, AI has the potential to transform industries, solve complex problems, and enhance our daily lives in remarkable ways.

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