Artificial Intelligence and Machine Learning: A Concept for Solving Arithmetic Problems

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ABSTRACT

Artificial Intelligence's (A.I.) key contribution to mathematics education is the development of concepts, methods, and tools enabling the building of adaptable and relevant computer-based systems for teaching and learning. Such technologies elicit high expectations, such as direct manipulation of abstract things, personalized explanations, and intelligent microworlds that allow learning by exploration. Many questions are related with these expectations, including, first and foremost, what can be learnt and what is learned through interaction with such AI-systems? However, other critical concerns must be addressed, such as the implications of AI modeling's knowledge reification and the design of user-friendly interfaces, as well as how such systems might collaborate with teachers in the mathematics classroom.

Key Words: Artificial Intelligence, Machine Learning, Linear algebra, Vector space, Eigen values and Eigen vectors.

INTRODUCTION

Artificial Intelligence (AI) is a fascinating and vital field. It's a burgeoning scientific field with a lot of potential for applications as well as a lot of research opportunities. At the same time, AI is a contentious topic. There is a history of high expectations and enormous investments, as well as major failures and disappointments.

Artificial Intelligence and Machine Learning are technical fields that rely heavily on mathematics and physics. Artificial Intelligence (AI) has gradually become a part of our everyday lives. AI has become a requirement before we even realized it. We were already completely reliant on it in every other aspect of our lives. It often appears as two separate domains in the learning of Mathematics and AI, despite the fact that they are two necessary branches of the same tree. Ethereal structures, routines, and ad-hoc/emergence programmes are all that either of them develops on their own. For the same reason, both disciplines must be studied sequentially

beginning at the lowest educational levels, as they are inextricably intertwined. Mathematics is crucial because it lays the groundwork for programming. When developing deep learning or AI algorithms, theories are utilised to make assumptions about the underlying data. It is critical that we comprehend the most significant probability distributions. Statistics, Linear Algebra, Probability, and Calculus are the four key principles that drive machine learning. While statistical ideas lie at the heart of all models, calculus aids in the learning and optimization of such models.

The fields of mathematics, statistics, probabilistics, electronics, and computer science all meet in machine learning. Machine learning is a technique for learning iteratively from data using algorithms and positive feedback to create intelligent applications. Machine learning is a branch of computer science that differs from typical computational access. Algorithms are specifically created for problem solving by computers in traditional programming. Machine learning, on the other hand, is the idea that a machine can learn without being explicitly programmed from previous experience and previously solved examples. Biometric attendance, fraud detection, facial recognition, and text recognition are just a few examples.

MACHINE LEARNING

Machine learning is a data analysis method that automates analytical modeling. Machine learning is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns, and make decisions with minimal human intervention [1].

Machine learning is similar to artificial intelligence, but it differs in that it does not aim to replicate solely human-like abilities in a machine. Some abilities, such as identifying patterns in millions of photos from a particle accelerator or billions of Facebook postings, may be simple for a machine but difficult for humans to master. Many human skills, on the other hand, appear to be beyond the scope of existing machine learning models, such as making beautiful music and proving arithmetic theorems.

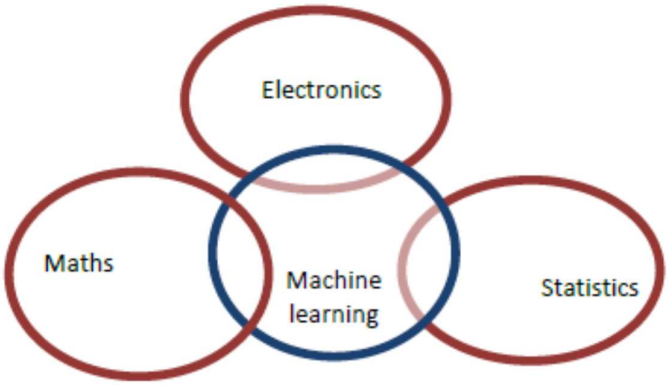

Fig. 1: InterdisciplinaryMachine Learning

Tom Michel Professor of Carnegie Mellon University is this: A computer program that, according to some T-tasks and Pfunction, forms the E experience, if its function in the T-task. Improve as measured by P with E experience [2].For example if a computer program can improve its performance in a task using its previous experiences then you can say that the machine has learned. And machine learning is the same as extracting knowledge from data [3].

Suppose a movie review consists of a paragraph or two of text, as well as a numerical score in [0; 1] (0 = worst and 1 = best). The machine is trying to learn how to predict the numerical score when given only the text part of the review. As training data, it is given N movie reviews and their scores; that is, $(x^1; y^1); (x^2; y^2); : : : ; (x^N; y^N))$ where x^i is a piece of text and y^i is a score. From this dataset it has to figure out the rule for predicting the score from the text.

A linear model is the most basic method of prediction. To make the description easier to understand, assume that each review is the same length, i.e., k words. The model assumes that each word is connected with a scalar sentiment weight. According to the model, the score of a review may be predicted by summing the sentiment weights of all terms in the review. It's important to remember that if a word appears k times, it gives k times its weight.

Mathematical AI is commonly connected with the AI school known as "logicists," and is strongly focused on mathematical logic. The logic is considerably more extensively involved. When an AI system reasons, it typically employs methods that are guaranteed to succeed, but only if they are achieved within specific time periods. Helene Kirchner describes strategies for making deduction more effective utilizing order relations while providing a wealth of general knowledge on logical reasoning in AI. The systems presented here are closely connected to those employed by Larry Wos and his group at Argonne, who focus on solving problems and proving theorems in pure mathematics.

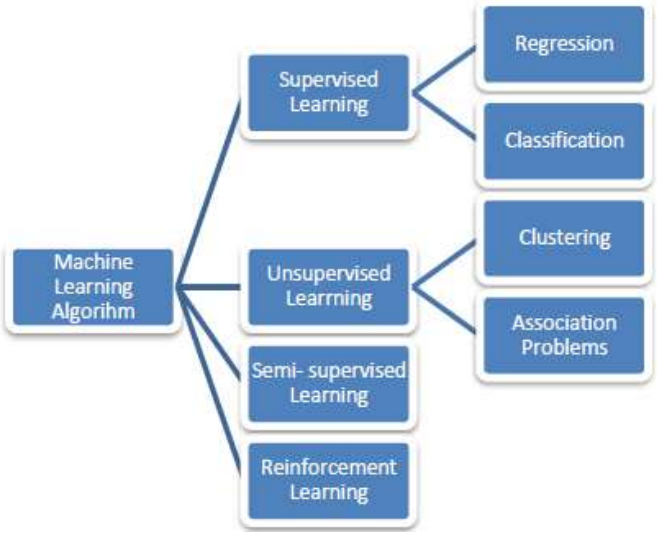

Fig. 2: Classification of Various Machine Learning Algorithms

Linear models can also be combined with nonlinear transformations of the model's inputs or outputs to describe nonlinear phenomena. These techniques are often employed in machine learning: kernel methods are arbitrary non-linear transformations of the inputs of a linear model, and the sigmoid activation curve is used to transform a smoothly varying output of a linear model into a hard yes or no decision [4].

MATHEMATICS BEHIND MACHINE LEARNING

Because mathematics is used at the backend, it is an important aspect of machine learning. Machine learning employs algorithms to collect data and then uses that data to generate predictions. Mathematical knowledge is required for Machine Learning. Algorithms are created using linear algebra, calculus, statistics, discrete mathematics, probability, and optimization. Accuracy, training time, model complexity, parameter setting, and validation procedures are all covered.

Linear Algebra: It serves as the foundation for machine learning. The X and Y matrix operations, which are part of linear algebra, are used to find the values of variables. As a result, linear algebra is required in machine learning. Not only are all of the operations in Linear Algebra systematic rules, but they also represent knowledge in a way that a computer can understand.

Multivariate Calculus: Machine learning algorithms are typically taught on a variety of factors. It aids in the proper quantification and prediction of data. Multivariate Calculus approaches used in machine learning include Laplacian and Lagragian Distributions, Vector-Valued Functions, Directional Gradient, Differential and Integral Calculus, Partial Derivatives, and Jacobian. Multivariate Calculus is used to calculate monthly rainfall, temperature, and wind speed, among other things.

Graph Theory: The flow of computing is represented by graphs. Machine learning algorithms can be learned using graph learning models. Graphs represent numerous matrices mathematically, whereas matrices supply many forms of information. K-mean, K-nearest neighbors, Decision trees, Random forest, and neural networks are examples of machine learning models with graph-like structures.

Some of the Mathematical Tools that are Used in Artificial Intelligence and Machine Learning

Mathematical Concepts Important for Artificial Intelligence and Machine Learning:

1) Linear Algebra
2) Calculus
3) Probability Theory
4) Discrete Math
5) Statistics

Loss functions, regularisation, covariance matrices, Singular Value Decomposition (SVD), Matrix Operations, and support vector machine classification are all examples of where linear algebra is used in machine learning methods. It's also used in linear regression and other machine learning algorithms. Logistic regression, distributions, discrimination analysis, and hypothesis testing are all part of descriptive statistics. Non-continuous numbers, usually integers, are the focus of discrete mathematics. Many applications necessitate the usage of discrete numbers.

The fundamental theorem of calculus is a theorem that ties the concepts of differentiating and integrating functions together. Apart from a constant value that relies on where one starts computing the area, the two processes are inverses of each other.

CONCLUSION

Machine learning is a branch of computer science that is constantly evolving. Machine learning is used to solve real-time problems in today's world by storing, manipulating, extracting, and retrieving data from large sources. In this paper, we look at how electronics, mathematics, and statistics can be used to design a machine learning model that is both efficient and effective. We use several machine learning tools in our daily lives, such as Google Translate and Google Directions. Many of us use these apps without realising how machine learning interacts with areas like math, statistics, and electronics. It's worth noting that the algorithms, approaches, and procedures that machine learning uses to solve issues will continue to evolve. In a nutshell, machine learning can learn from ideas and adapt to changing circumstances with high accuracy, speed, and precision.

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