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AI : Some mathematical tools in machine learning

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Abstract :

Machine learning (ML) is a subset of artificial intelligence (AI) that focuses on developing systems that can learn from data and improve their performance over time without being explicitly programmed. Instead of being hardcoded with rules, these systems use algorithms to identify patterns and make predictions or decisions. Here's a comprehensive overview of theses algorithms :

- Supervised Learning

- Unsupervised Learning

- Semi-Supervised Learning

- Self-Supervised Learning

- Reinforcement Learning

- ...

The most used mathematical domains in Machine Learning are

- Algebra (matricial calculus, linear regression, principal component analysis (PCA), neural networks, ...)

- Algebraic topology (category, functor, morphism, ...)

- Differential and Integral Calculus (optimisation, gradient descent, parameters choice, ...)

- Probability Theory and Statistics (inferences from data, Bayesian networks, Markovian Models, ...)

- Information Theory (entropy to measure, modelling, ...)

- Numerical Analysis (implementing fast machine learning algorithms, approximation, error analysis, ...)

- Differential geometry (curved surfaces, Riemannian structure, local metric using Fisher Information, ...)

- ...

This presentation aims to initiate a dialogue among computer scientists and mathematicians regarding the critical interdisciplinary research areas that necessitate synergistic collaboration between the two fields.

Keywords : AI (artificial intelligence), entropy, Fisher Information, gradient descent, ML (Machine learning), Markovian Model, Riemannian structure.

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