

Understanding AI Through Mathematics

It provides a rigorous mathematical framework required to design, analyse, and optimize modern **AI and ML systems**.

It covers **Linear Algebra** — including vector spaces, linear transformations, Eigen decomposition, and SVD — forming the backbone of Neural Networks, PCA-based dimensionality reduction, recommendation engines, and computer vision systems.

It includes **Probability Theory and Statistical Inference**, enabling intelligent decision-making under uncertainty through concepts such as random variables, probability distributions, Bayes' Theorem, and hypothesis testing — widely applied in spam filtering, fraud detection, weather forecasting, and medical diagnosis models.

It emphasizes **Multivariable Calculus** (gradients, Jacobians, Hessians) and its application in backpropagation and deep learning optimization. Advanced **Optimization Techniques** — including Gradient Descent variants, Convex Optimization, and Lagrange multipliers — explain how AI models minimize loss functions efficiently during training. Core ML algorithms such as **Linear Regression, Logistic Regression, and Clustering methods** are derived from first principles to build deep conceptual understanding beyond software tools.

In everyday life, these mathematical foundations power technologies like Google Maps route optimization, Netflix and Amazon recommendations, voice assistants, facial recognition in smartphones, stock market prediction systems, and personalized social media feeds. By bridging mathematical theory with real-world AI applications, it transforms learners into analytical AI practitioners capable of building scalable, research-driven intelligent systems.