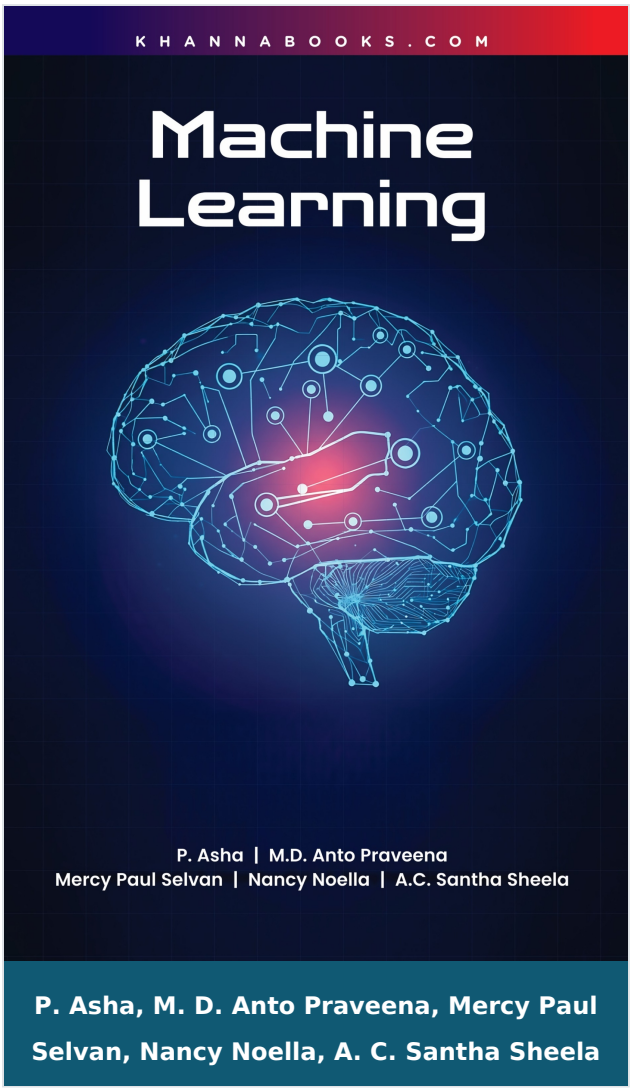


**P. Asha, M. D. Anto Praveena, Mercy Paul Selvan, Nancy Noella, A. C. Santha Sheela**

# Machine Learning

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## Product Description

MACHINE LEARNING: A Theoretical and Practical Guide is an essential introductory textbook meticulously designed to equip students and researchers with a robust theoretical foundation and critical practical insights into the rapidly evolving field of data analytics. Addressing the core principles of machine learning (ML), the book systematically explores the diverse ML types—Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning—while meticulously detailing their mathematical underpinnings and theoretical frameworks.

The book begins with an exploration of fundamental learning concepts, including the Bias-Variance Tradeoff and VC Dimension, before delving into core algorithms. It provides comprehensive coverage of key techniques for real-world problem-solving, such as Association Analysis for recommendation systems, and foundational Classification algorithms like Decision Trees and Naïve Bayesian Classifiers. Complex topics are simplified through a thorough analysis of parametric estimation, multivariate techniques, and crucial dimensionality reduction methods like PCA and LDA. Furthermore, the text offers practical solutions for Clustering and Outlier Detection, which are vital for achieving effective generalization. A dedicated section introduces Neural Networks, from single-layer perceptrons to Multi-layer Perceptrons and Backpropagation, culminating in a discussion of advanced local models and ensemble techniques like Bagging and Boosting. Finally, the book highlights emerging research in Reinforcement Learning, positioning it as a valuable resource for tackling complex engineering and open research challenges. This volume serves as an invaluable roadmap for aspiring data scientists and established academics seeking to master modern ML principles.

Salient Features:

• Foundational Learning Paradigms: Details the four main types of learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning, providing context for

various algorithms.

• Core Algorithms Analyzed: Provides in-depth coverage of crucial models such as Decision Trees, Naïve Bayes Classifiers, K-Means clustering, and Linear Regression.

• Mathematical Underpinnings: Explains the theoretical frameworks of ML, including Bayesian Decision Theory, PAC Learning, and the Bias-Variance Tradeoff in model building.

• Data Reduction Techniques: Features practical chapters on essential dimensionality reduction methods like Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for data preprocessing.

• Neural Network Deep Dive: Introduces the architecture and training of neural networks, covering perceptrons, Multi-Layer Perceptrons, and the Backpropagation algorithm.

• Advanced Local Models: Includes detailed explanations of competitive learning, Self-Organizing Maps (SOM), and Radial Basis Function (RBF) networks for advanced data grouping.

• Model Optimization Strategies: Explores ensemble methods, specifically Bagging and Boosting (including AdaBoost and Gradient Boosting), for improving model accuracy and stability.

• Future Learning Paradigms: Highlights emerging research in Reinforcement Learning, explaining its workflow, terminologies, and key models like Markov Decision Processes (MDPs) and Q-Learning.

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