

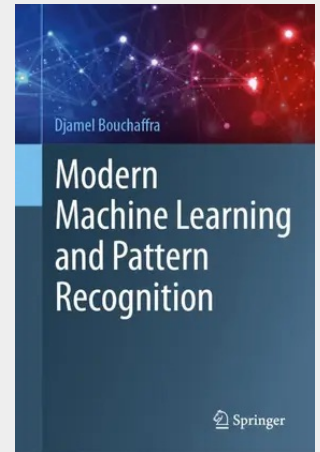
Modern Machine Learning and Pattern Recognition

presents a rigorous, comprehensive exploration from classical learning paradigms to the latest deep architectures and large language models. Integrating supervised, unsupervised, self-supervised, and reinforcement learning with modern neural network design, the book offers a unified view of machine learning and pattern recognition grounded in statistical learning theory and optimization. Through a progression of chapters, readers move from foundations and multilayer perceptrons to convolutional and recurrent networks, generative adversarial models, and transformer-based large language models.

A special feature of this text is its combination of theoretical depth with extensive practice-oriented material, including many exercises, Python-based projects, and real-world case studies that bridge mathematical analysis with implementation and experimentation. Beyond just standard architectures, the book introduces original coalitional neural models with energy-based foundations, drawing on statistical physics, game theory, and random matrix theory to analyze and redesign deep networks at a fundamental level. It concludes with dedicated chapters on the ethical and social implications of large-scale models and on emerging research directions such as topological data analysis, meta-reasoning in LLMs, and causal inference: helping readers connect core techniques to current debates and future developments in AI.

Meant for advanced undergraduates, graduate students, researchers, and professionals, this single-author monograph provides a coherent and pedagogically structured treatment suitable for classroom adoption, self-study, and reference. Readers are equipped not only to understand existing models, but also to engage with ongoing research on interpretability, robustness, and the next generation of learning architectures.

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