Python & Mathematics for Data Science and Machine Learning

Executable Math for Data Science and ML

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Preface

Math you can run. That's the spirit of this book: every definition, claim, or diagram can be checked with a few lines of readable Python. When ideas and numbers agree, intuition sticks.

Why this book and why now?

Practical ML and modern AI rest on a small core: linear algebra for shapes and projections; calculus for sensitivities; probability for uncertainty; optimization for learning; and a disciplined way to make claims falsifiable. Python lowers the activation energy. NumPy arrays make algebra concrete; Matplotlib turns signal into sight; tiny experiments make mistakes visible and progress tangible.

How to use this book

Follow the "Math ↔ Code" loop: learn the concept, run the smallest check you can write, and read the result. Repeat until it feels obvious. Keep runs reproducible: set seeds, print shapes and scalars, and save figures with captions that say what to observe. Treat exercises as experiments. They do not test memory — they teach reflexes: framing, checking, and communicating results.

What's inside

Parts I–III build the language: vectors and matrices as actions; derivatives as local models; landscapes and the chain rule as engines for learning. Parts IV–V make uncertainty and optimization usable: distributions you'll see often; calibration that makes probabilities honest; convexity and constraints that keep solutions meaningful; stochastic methods that scale. Parts VI–VII bridge to practice: end-to-end modeling; attention and embeddings; autodiff and PyTorch; small patterns that carry into transformers and LLMs.

If at any point you feel stuck, shrink the problem. Smaller shapes, fixed seeds, and one printed number will get you moving again. Keep your curiosity, and let the code keep you honest.

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The AI Engineer

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