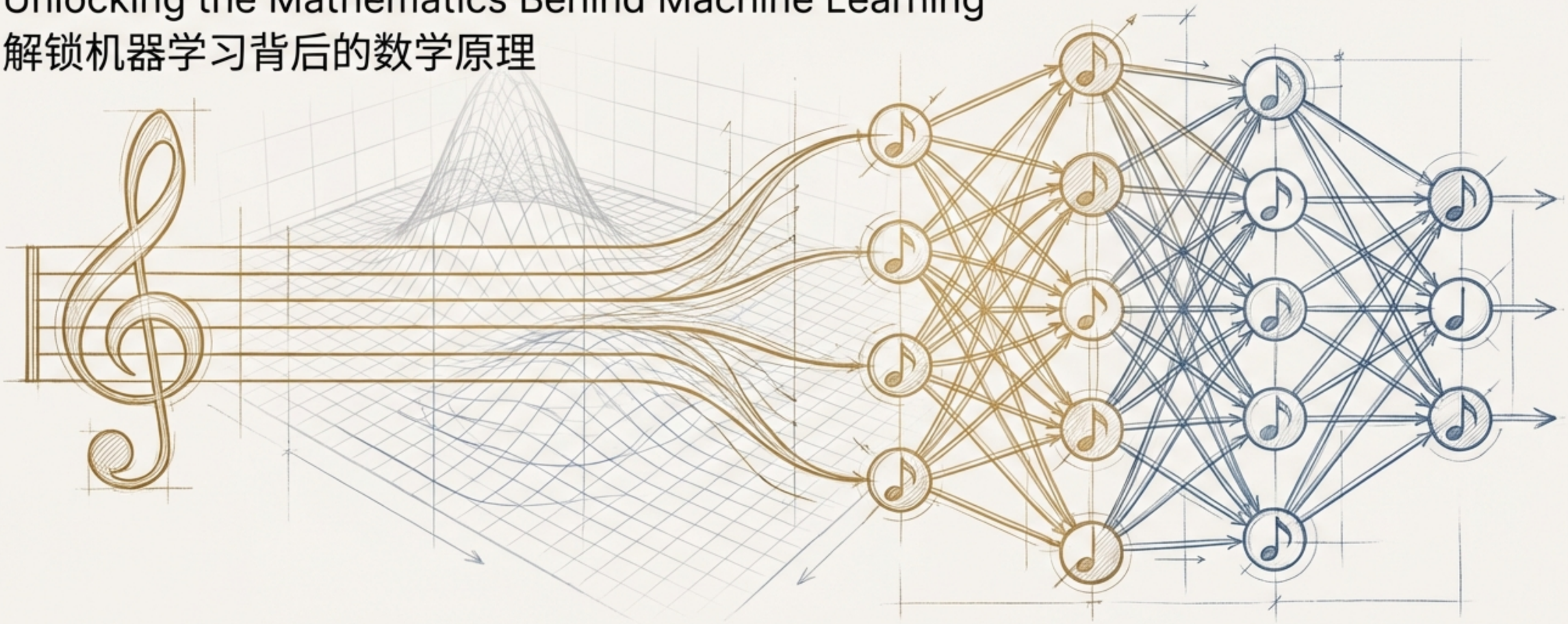
The ML Orchestra: From Listener to Composer

机器学习乐团：从聆听者到作曲家

Unlocking the Mathematics Behind Machine Learning

解锁机器学习背后的数学原理



Based on Mathematics for Machine Learning by Deisenroth, Faisal, and Ong. / 基于 Deisenroth, Faisal, Ong 所著《机器学习的数学》。

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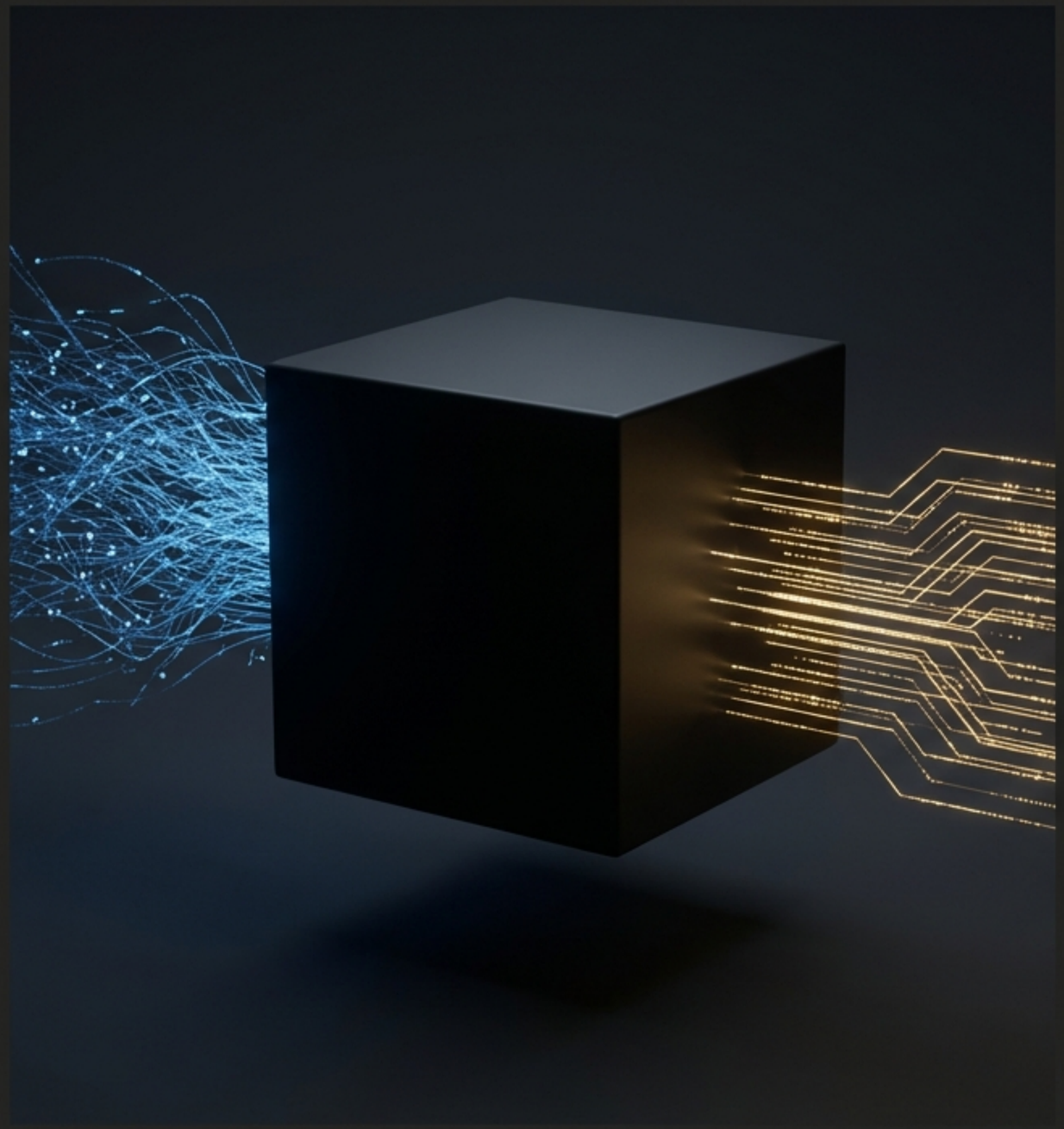

The Allure and Danger of the ‘Black Box”

“黑箱”的魅力与风险

"As machine learning becomes more ubiquitous and its software packages become easier to use, it is natural and desirable that the low-level technical details are abstracted away... However, this brings with it the danger that a practitioner becomes unaware of the design decisions and, hence, the limits of machine learning algorithms.”

「随着机器学习变得越来越普及，其软件包也越来越易于使用，将底层技术细节抽象化并对从业者隐藏起来，是很自然且可取的。然而，这也带来了风险，从业者可能会意识不到算法的设计决策，从而不了解其局限性。」

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A New Analogy: Machine Learning as Music
一个新的类比：将机器学习视为音乐

“In analogy to music, there are three types of interaction that people have with machine learning.”

「与音乐相类似，人们与机器学习的互动可以分为三种类型。」

Let's explore these roles and find where you fit in the ML Orchestra.
让我们一同探索这些角色，看看您在机器学习乐团中身处何位。

The Astute Listener: Appreciating the Symphony
敏锐的聆听者：欣赏交响乐

Users can focus on extracting insights from data using off-the-shelf tools... This is similar to listening to music; the user is able to choose and discern between different types of machine learning... More experienced users are like music critics, asking important questions about... ethics, fairness, and privacy.

「用户可以专注于使用现成的工具从数据中提取洞见... 这就像听音乐；用户能够选择和辨别不同类型的机器学习... 更有经验的用户则像音乐评论家，会提出关于... 伦理、公平性和个人隐私等重要问题。」

- Democratization / 普及化
- Off-the-shelf tools / 现成工具
- Domain Experts / 领域专家
- Critics / 评论家

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The Experienced Artist: Playing the Instruments
经验丰富的艺术家：演奏乐器

"Skilled practitioners... can plug and play different tools and libraries... This is similar to a virtuoso playing music, where highly skilled practitioners can bring existing instruments to life... Using the mathematics presented here as a primer, practitioners would be able to understand the benefits and limits of their favorite method."

「熟练的从业者可以将不同的工具和库“即插即用”... 这就就像一位演奏大师，技艺高超的他们能让现有的乐器焕发新生... 以本书介绍的数学为基础，从业者将能够理解他们喜爱方法的优点和局限性。」

- Plug and Play / 即插即用
- Virtuoso / 演奏大师
- Understand Limits / 理解局限

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The Fledgling Composer: Writing the Music

初出茅庐的作曲家：谱写乐曲

"Developers of machine learning need to develop new methods and extend existing algorithms... This is similar to composers of music who, within the rules and structure of musical theory, create new and amazing pieces. There is a great need in society for new researchers who are able to propose and explore novel approaches."

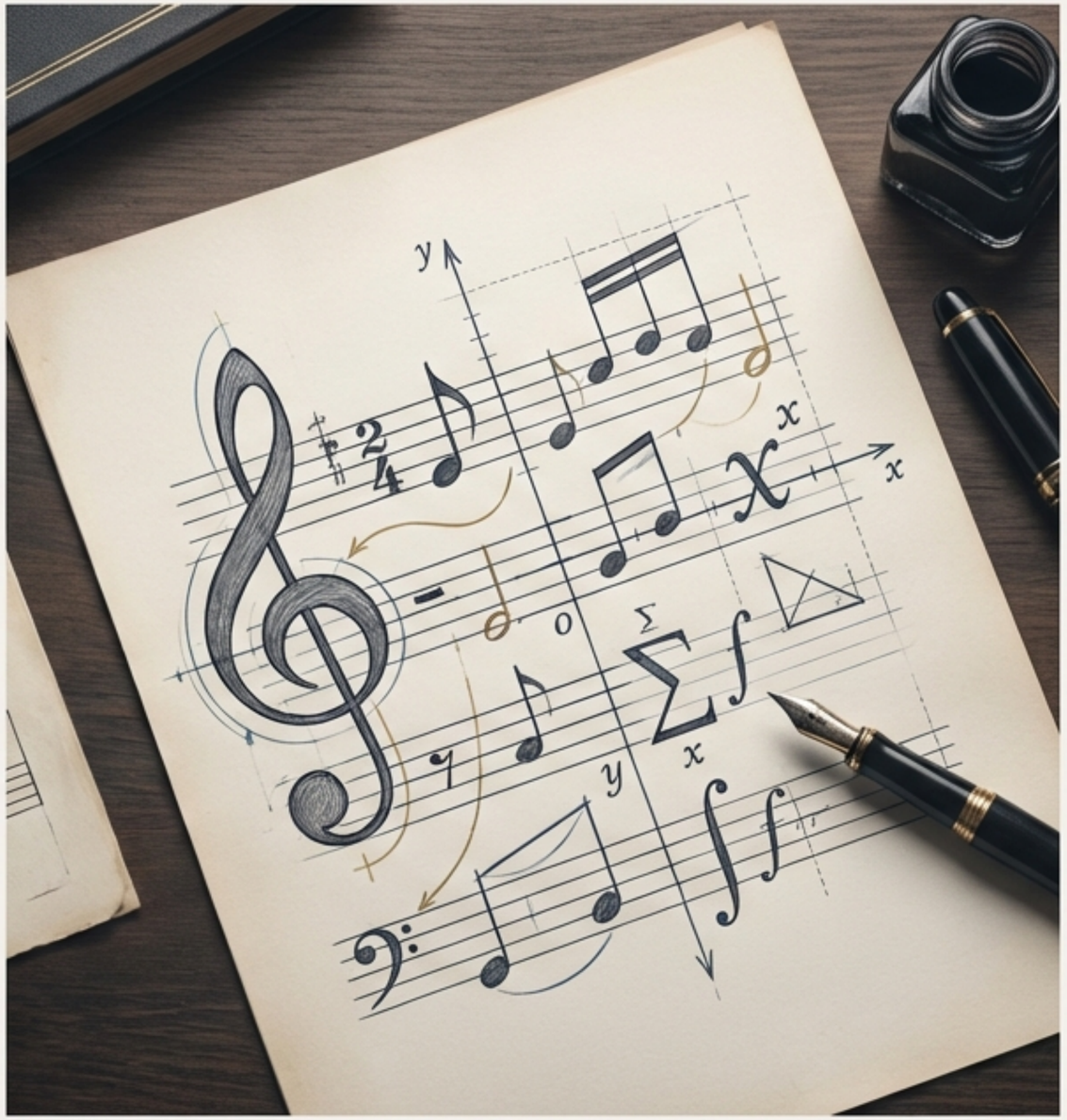
「机器学习的开发者需要开发新方法并扩展现有算法... 这就像音乐作曲家，在音乐理论的规则和结构内，创作出全新而精彩的作品。社会非常需要能够提出和探索新方法的新研究人员。」

Develop New Methods / 开发新方法

Researchers / 研究人员

Mathematical Basis / 数学基础

Create / 创造



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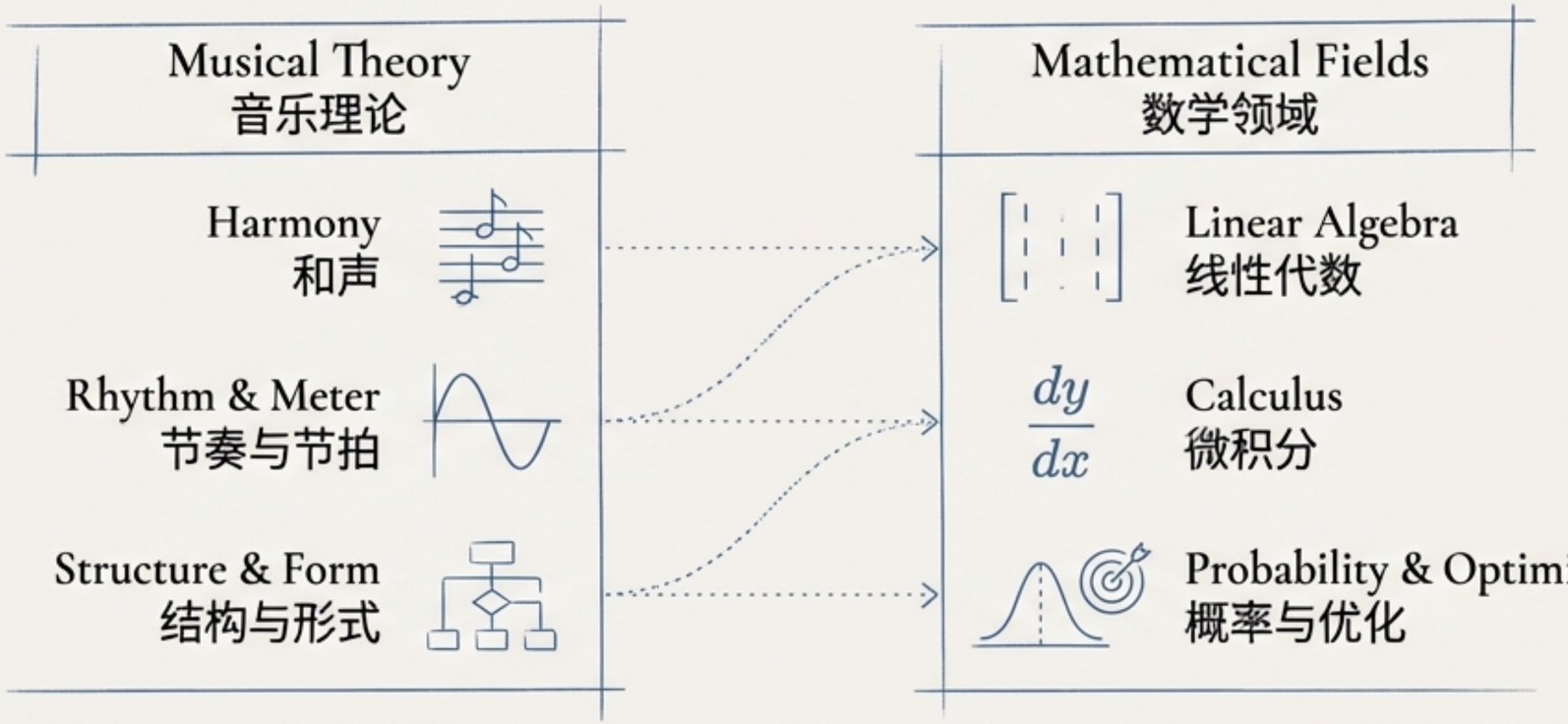
Mathematics is the Sheet Music for Machine Learning
数学是机器学习的乐谱



"We believe that the mathematical foundations of machine learning are important in order to understand fundamental principles... Understanding these principles can facilitate creating new machine learning solutions, understanding and debugging existing approaches, and learning about the inherent assumptions and limitations of the methodologies we are working with."

「我们认为，机器学习的数学基础对于理解基本原理至关重要... 理解这些原理有助于创建新的机器学习解决方案，理解和调试现有方法，并了解我们所使用方法的内在假设和局限性。」

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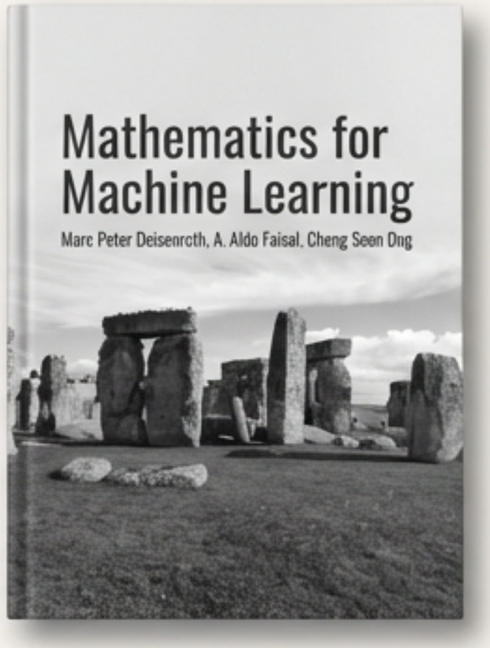
Your Guide to the Orchestra / 您的乐团指南



Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong

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免费下载，旨在普及教育和学习。

https://mml-book.com

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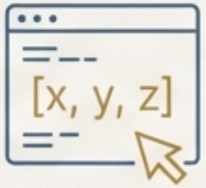
Finding the Words for Our Intuitions
为我们的直觉找到精准的语言

The book helps formalize concepts we often use intuitively. For example, what exactly is a “vector”?
本书帮助我们将一些习以为常的概念形式化。例如，究竟什么是“向量”？



1. The Computer Science View (计算机科学视角)

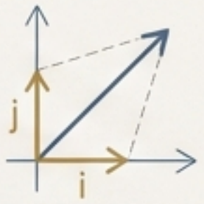
A vector as an array of numbers.

向量是数字数组。

2. The Physics View (物理学视角)

A vector as an arrow with a direction and magnitude.

向量是具有方向和大小的箭头。



3. The Mathematical View (数学视角)

A vector as an object that obeys addition and scaling.

向量是遵循加法和数乘运算的对象。

The book uses Linear Algebra to unify these views, focusing on their shared properties.
本书通过线性代数统一这些视角，专注于它们的共通属性。

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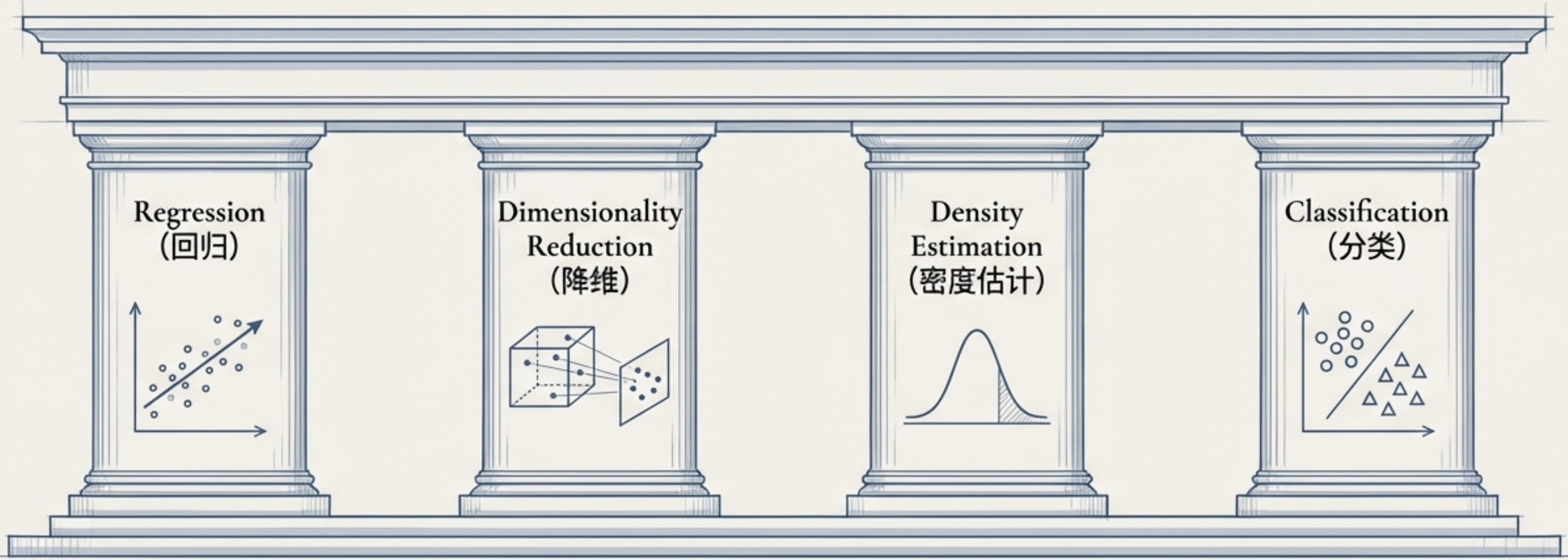
The Four Pillars of Practice / 实践的四大支柱

The journey culminates in four key machine learning applications, built upon the mathematical foundations.
本书的旅程最终聚焦于四个关键的机器学习应用，它们都建立在坚实的数学基础之上。



Predicting real-valued labels (e.g., price).
预测实数值标签（例如，价格）

Finding a compact representation of high-dimensional data.
寻找高维数据的紧凑表示

Modeling the underlying probability distribution of a dataset.
对数据集的底层概率分布进行建模

Predicting discrete, integer labels (e.g., categories).
预测离散的整数标签（例如，类别）

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Part I: Mastering the Mathematical Foundations
第一部分：掌握数学基础

Chapter 2: Linear Algebra / 线性代数

Chapter 3: Analytic Geometry / 解析几何

Chapter 4: Matrix Decompositions / 矩阵分解

Chapter 5: Vector Calculus / 向量微积分

Chapter 6: Probability and Distributions / 概率与分布

Chapter 7: Continuous Optimization / 连续优化

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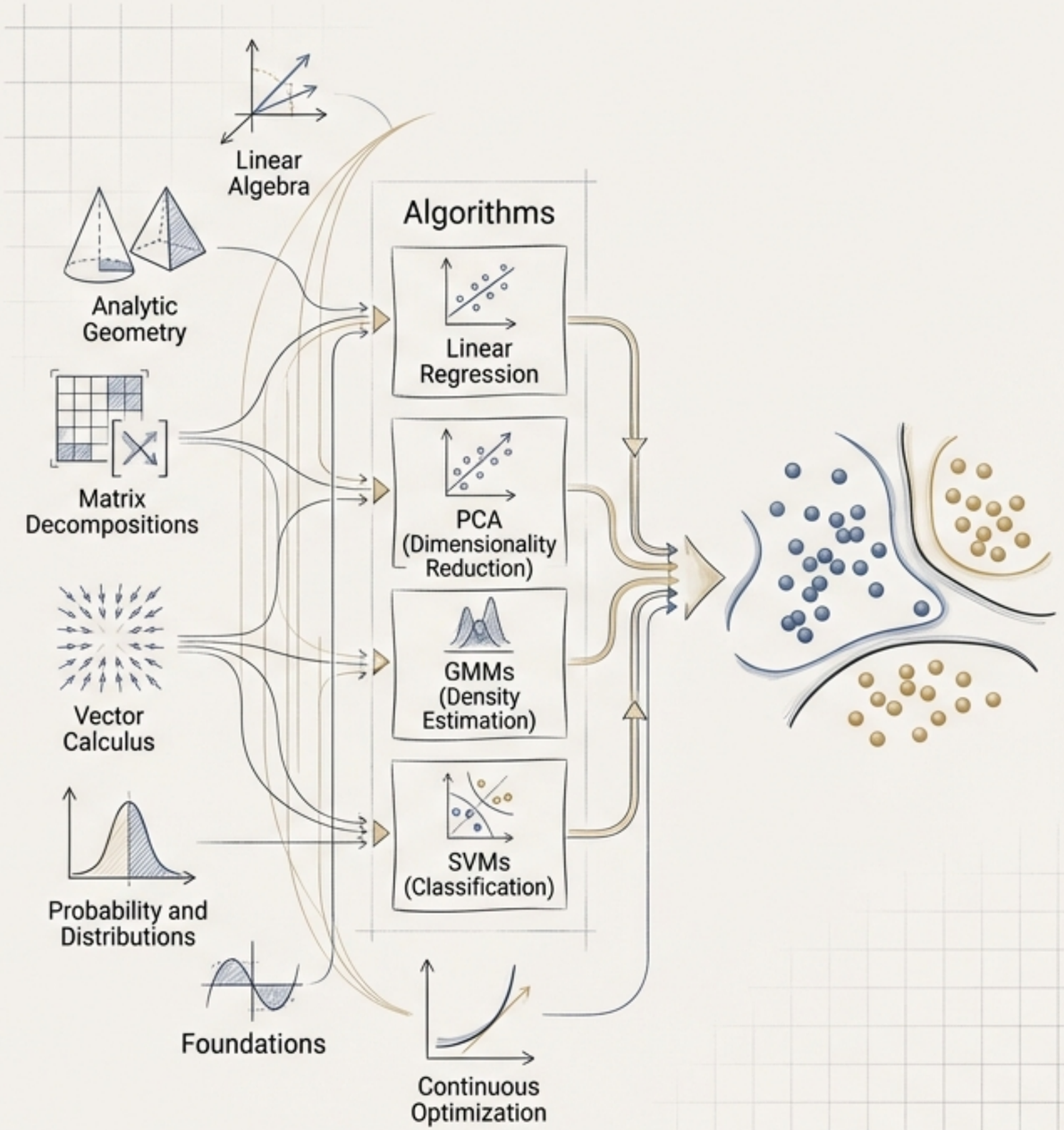
Part II: Composing with Machine Learning Algorithms / 第二部分：运用机器学习算法进行创作

Chapter 9: Linear Regression
线性回归

Chapter 10: Dimensionality Reduction with PCA
使用PCA进行降维

Chapter 11: Density Estimation with GMMs
使用高斯混合模型进行密度估计

Chapter 12: Classification with SVMs
使用支持向量机进行分类



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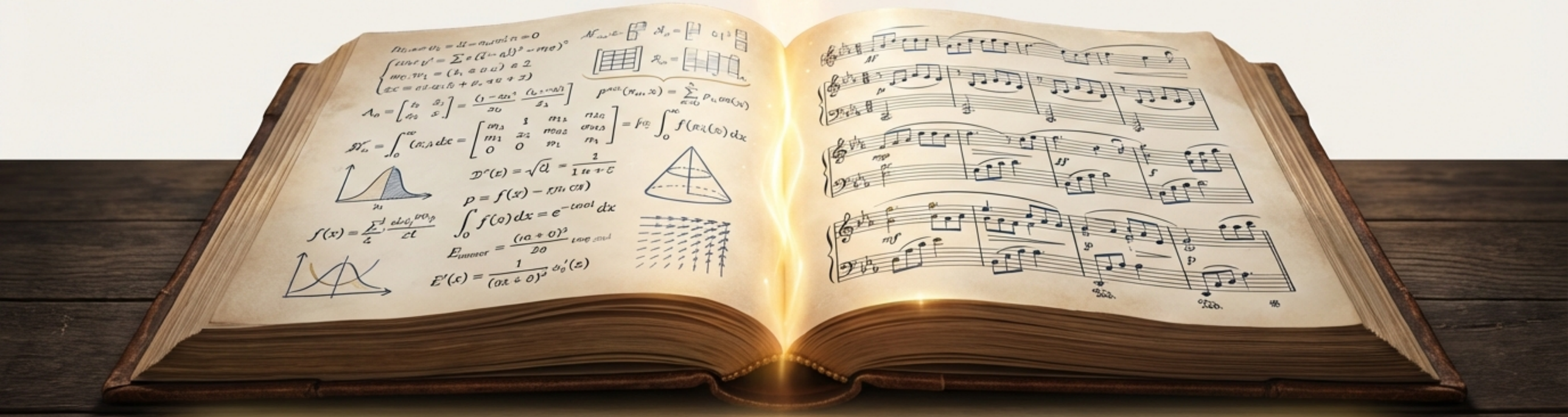
Your Invitation to Compose / 诚邀您加入创作的行列

Whether you are an Astute Listener, an Experienced Artist, or a Fledgling Composer, a deeper understanding of the ‘musical theory’ of ML empowers you. It is the key to more rigorous development, novel applications, and true innovation.

无论您是敏锐的聆听者、经验丰富的艺术家，还是初出茅庐的作曲家，对机器学习“乐理”的深入理解都将赋予您力量。这是通往更严谨的开发、新颖的应用和真正创新的关键。



Begin your journey. The sheet music is open. / 开启您的旅程。乐谱已为您展开。

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