Mathematics for Machine Learning

Notes of the book Mathematics for Machine Learning (https://mml-book.github.io/book/mml-book.pdf) by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong

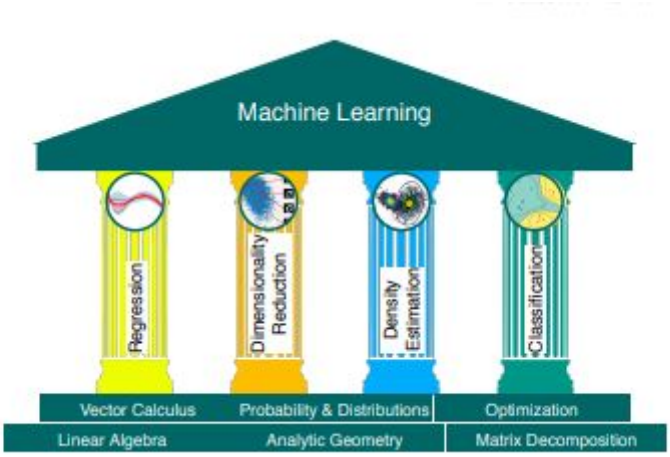

Figure 1.1 The foundations and four pillars of machine learning.

- **representations** of numerical data as vectors and a table of such data as a matrix => linear algebra
- The construction of **similarity and distances between vectors** is central to analytic geometry
- **matrices and matrix decomposition** that allow for an intuitive interpretation of the data and more efficient learning.
- Data often considered as noisy observations. The quantification of uncertainty is the realm of **probability theory**.
- Training of the model or optimization techniques often require the concept of a gradient => **vector calculus and optimization**

4 pillars:

- **linear regression**: classical model fitting (parameter estimation) via maximum likelihood and maximum a posteriori estimation, as well as Bayesian linear regression, where we integrate the parameters out instead of optimizing them
- **dimensionality reduction**, using principal component analysis
- **density estimation**: find a probability distribution that describes a given dataset with a focus on Gaussian mixture models
- **classification** in the context of support vector machines

Linear Algebra

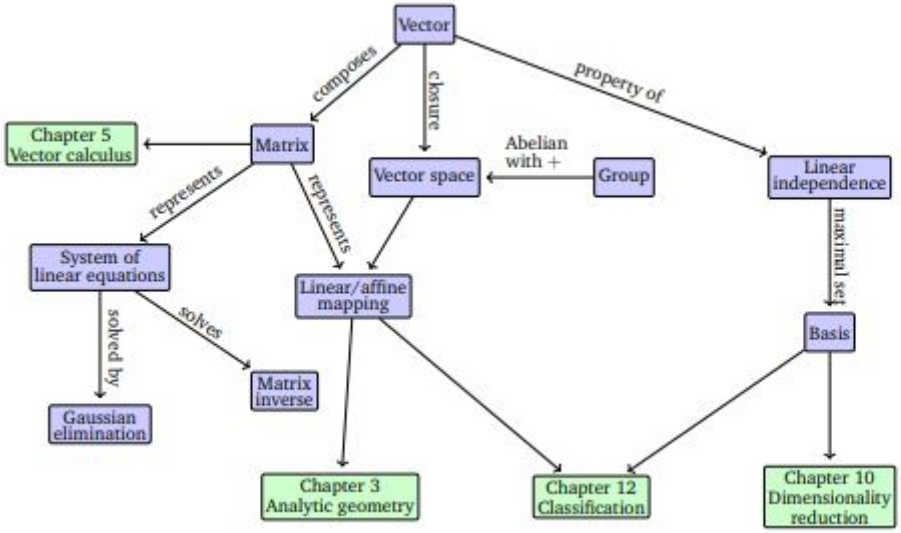

Figure 2.2 A mind map of the concepts introduced in this chapter, along with where they are used in other parts of the book.