

Mathematical Methods for Machine Learning

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[Tie20] VŨ HỮU TIỆP. *Machine Learning Cơ Bản*.

[DF023] MARC PETER DEISENROTH, A. ALDO FAISAL, CHENG SOON ONG. *Mathematics for Machine Learning*. 2023.

Target Audience. Mainly: Engineering- & CS undergraduate students.

Note: Mathematics undergraduate students, especially academic-oriented (researchers), need much more rigorously theoretical mathematical foundations for ML.

Goal/Objective

Learn enough mathematics to be able to balance our comprehension in both mathematical- & technical (engineering) aspects of Machine Learning: Adjust “suitable” coefficients $\alpha, \beta, \gamma \in (0, 1)$ s.t. $\alpha + \beta + \gamma = 1$ &

$$\text{Maximize Goal(What, How, Why)} := \alpha \text{What} + \beta \text{How} + \gamma \text{Why}. \quad (1)$$

where the functional $\text{Goal(What, How, Why)}$ depends on your target job(s) & purpose(s).

Audiences & Goals

Distinguish 2 different perspectives/orientations for a CS student:
Engineering-oriented & Mathematics-oriented.

Engineering perspective

Engineers need to learn various What (definitions, tools) & mainly focus on How (technicalities, tools), “practical Why” & a little bit on “theoretical Why”.

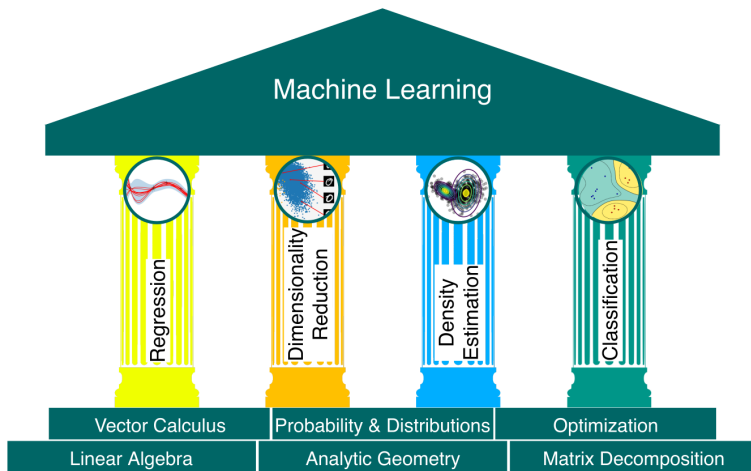
E.g.: *Why/How does this algorithm/model work? Why/How does(n't) my code work?*

Mathematics perspective

Mathematicians have to learn & build various What (definitions, concepts), mainly focus on “theoretical Why” (logic, rigorous proof), then on How (mathematical tools)

E.g.: *Why/How is this model “optimal” in mathematical sense?*

Prerequisites



Hình: Foundations & 4 pillars of ML. Source: [DFO23, Fig. 1.1, p. 14].

Prerequisites

Linear Algebra

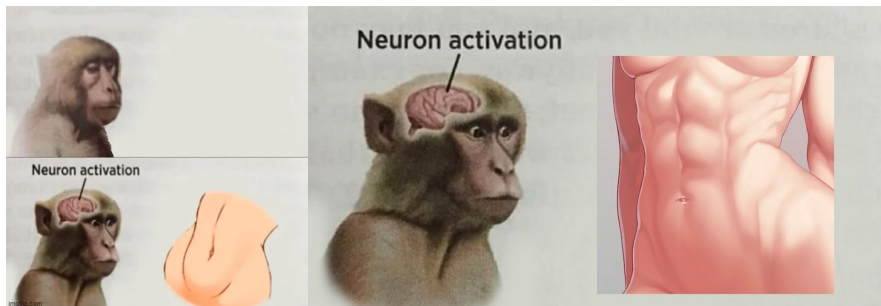
Probability

Statistics

Artificial Neural Networks (ANNs)

Distinguish: ANN vs. BNN.

Activation function $\sigma(\cdot)$



Hình: A typical monkey's (maybe man also) biological neural networks (BNN) gets activated by 2D/anime girl's strong abs.