Machine learning for physicists

PHYS-467

Prof: Lenka Zdeborová, SPOC laboratory, lenka.zdeborova@epfl.ch.

TAs: Lucas Clarte, Hugo Cui, Christian Keup, Luca Biggio, Alessandro Favero

lucas.clarte@epfl.ch, hugo.cui@epfl.ch, christian.keup@epfl.ch, luca.biggio@inf.ethz.ch (soon @epfl.ch), alessandro.favero@epfl.ch

Organisation

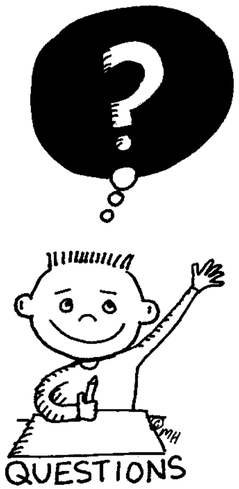
- Lecture (Fr 8h15-10h00, CE 1 4).
- Exercises (Fr 10h15-12h00, CE 1 4, with your own laptops). As (or more) important as the lecture.
- Lectures are recorded and put on Mediaspace. Link: https://mediaspace.epfl.ch/channel/PHYS-467%2BMachine%2Blearning%2Bfor%2Bphysicists/30395 (includes lectures from 2022)
- Exercises are not recorded. Solutions and notebooks are published on Moodle.
- All key information and lecture notes on Moodle https://moodle.epfl.ch/course/view.php?id=16718
- Q&A during lectures and exercises. Q&A ok by mail to TAs, preferably on Moodle.
- Language: English. Feel free to ask your questions or hand homework in French.

How will you be evaluated?

- 50%: 3 graded exercises during the semester to be done at home within 2 weeks time. Mainly coding, in a Jupyter notebook on GoogleColab. Approximately after lectures 4, 8, and 12. Solved individually. All material used (codes, books, articles, chatGPT) must be duly cited along with the names of everyone you discussed the content with. Download on Moodle.

- 50%: Final exam (3h) during the exam season. Questions on concepts and some calculations. No computer on the final exam. An A4 page (one side) of personal notes.

Question on the organization?



What will you learn?

- Programming in Python. Learn how to learn a new programming language (easier than c++).
- Machine learning as a tool in physics and sciences helping us to extract information from data.
- Think about physics/science in a data-oriented manner.
- Foundations and principles of machine learning methods. Starting with linear regression and ending with state-of-the-art systems such as Transformers and Large Language Models.

What should physics master students know about machine learning?
Why is this important for them?

The Spirit

Way to think about it: “Physics bachelor lecture on electromagnetism is to iPhone15 what this lecture is to ChatGPT.”

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t}$$