Machine learning for physicists

PHYS-467

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Organisation

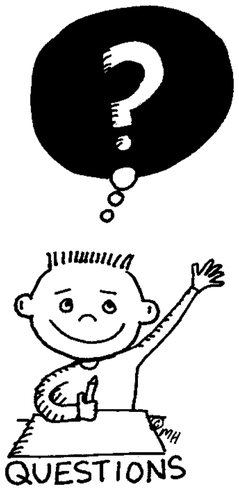
- Lecture (Fr 8h15-10h00, CE 1 4).
- Exercises (Fr 10h15-12h00, CE 1 4, with your own laptops). As (or more) important as the lecture.
- Lectures are recorded and put on Mediaspace. Link: https://mediaspace.epfl.ch/channel/PHYS-467%2BMachine%2Blearning%2Bfor%2Bphysicists/30395 (includes lectures from 2023)
- 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. To be uploaded on Moodle.

- 50%: Final exam (3h) during the exam season. Questions on concepts, some calculations, and question on pieces of code from the exercises. No computer on the final exam. An A4 page (one side) of personal notes (either handwritten or at least 10pt font).

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 for 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.

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

Ask ChatGPT …. The answer is quasi-perfect.

The Spirit

Way to think about it: “Physics bachelor lecture on electromagnetism is to iPhone16 what this lecture is to ChatGPT.”

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

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

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

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