PHYS-754

Lecture series on scientific machine learning

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Cursus	Sem.	Type
Computational and Quantitative Biology		Opt.
Computer and Communication Sciences		Opt.
Electrical Engineering		Opt.
Materials Science and Engineering		Opt.
Neuroscience		Opt.
Physics		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Oral presentation
Workload	60h
Hours	**42**
Courses	14
Project	28
Number of positions	**42**

Frequency

Every 2 years

Remark

Next time: Fall 2026

Summary

This lecture presents ongoing work on how scientific questions can be tackled using machine learning. Machine learning enables extracting knowledge from data computationally and in an automatized way. We will learn on examples how this is influencing the very scientific method.

Content

Machine learning is a data analysis and computational tool that in the last two decades brought groundbreaking progress into many modern technologies. What is more, machine learning is becoming an indispensable tool enabling progress in many scientific disciplines where knowledge is deduced from data.
This course will present some recent works in this direction. In the first part of the course works of different EPFL laboratories that use machine learning to address scientific questions in physics, chemistry, material science and biology will be presented.
Professors involved include: Lenka Zdeborova, Giuseppe Carleo, Michele Ceriotti, Philippe Schwaller, Martin Schrimpf, Anne-Florence Bitbol, David Harvey. Examples of problems covered include neural-network enhanced solutions of the Schrodinger equation in a variety of contexts, machine learning for the prediction and rationalization of chemical and physical properties of materials, analysis of proteins from their sequence and structure, or automated data analysis and modeling brain-function in neuroscience, application in astrophysics. In the second part of the lecture students will read, present and discuss selected recent articles on the subject.
Prior basic notions of machine learning are required, any of the introductory courses to machine learning is suitable. This lecture is accessible to all students across disciplines interested in natural and computational sciences.

Keywords

machine learning, neural networks, scientific machine learning

Learning Prerequisites

Required courses

Introduction to machine learning

Learning Outcomes

By the end of the course, the student must be able to:

- Orient themselves in scientific problems where tools of machine learning may be applied
- Be able to understand and discuss the related literature
- Identify suitable questions and tools.

Resources

Références suggérées par la bibliothèque

- Machine Learning and the Physical Sciences / Carleo et al.

Moodle Link

- https://go.epfl.ch/PHYS-754