EPFL

ME-390 **Foundations of artificial intelligence**

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Cursus	Sem.	Type
Mechanical engineering minor	H	Opt.
Mechanical engineering	BA5	Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course provides the students with 1) a set of theoretical concepts to understand the machine learning approach; and 2) a subset of the tools to use this approach for problems arising in mechanical engineering applications.

Content

Tools
Supervised learning: regression and classification
Unsupervised learning: singular value decomposition, K-means
Deep learning: brief introduction to neural networks
Reinforcement learning: brief introduction to policy gradient method

Theory
Optimization: role of convexity, gradient descent, least-squares
Statistics: Bayesian approach, bias and variance trade-off

Keywords

machine learning, artificial intelligence

Learning Prerequisites

Required courses

Real Analysis, Probability and Statistics, Linear Algebra

Learning Outcomes

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

- Identify a problem as supervised learning, unsupervised learning and reinforcement learning
- Formulate the problem of regression and classification using a hypothesis class and a loss function
- Model an optimization framework to address learning in the above problems given a linear or feedforward neural network hypothesis class
- Implement the learning problem above on a data set from mechanical engineering examples
- Analyze structure in data using SVD and K-means
- Distinguish training and test-error and tune the model to tradeoff these errors
- Explain the limitations of a data-driven learning approach

Transversal skills

- Write a scientific or technical report.
- Take account of the social and human dimensions of the engineering profession.
- Communicate effectively, being understood, including across different languages and cultures.
- Access and evaluate appropriate sources of information.
- Respect relevant legal guidelines and ethical codes for the profession.

Teaching methods

There will be two-hour lectures and one-hour exercise classes. The lectures will be based on slides and hand-written notes. The exercise hour will focus on assigned theoretical and coding exercises.

Expected student activities

participation in class, working on theory and coding assignments

Assessment methods

Written final exam (70%) and lab reports (30%)

Resources

Bibliography

Machine Learning for Engineers, Using Data to Solve Problems for Physical Systems by Ryan G. McClarren

Ressources en bibliothèque

- Machine Learning for Engineers, Using Data to Solve Problems for Physical Systems by Ryan G. McClarren

Notes/Handbook

There will be hand-written notes. The notes will be posted after the lecture. Other relevant online resources will be specified for each lecture.

Moodle Link

- https://go.epfl.ch/ME-390