Introduction to Machine Learning

Instructor:

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Overview:

The course is a very concise introduction to the subject of Machine Learning (ML), a part of articial intelligence (AI) that uses data analysis techniques applied to complex problems to, for example, reduce the dimensionality of the data set or to predict or infer certain values or outcomes from the given data. Supervised and unsupervised learning algorithms are described. Both predict outputs from give inputs, but in the supervised learning the algorithm learns from sets of given inputs-outputs samples, whereas for unsurpervised algorithms only inputs samples are given. And finally neural networks are described.

The prerequisites are linear algebra and programming skills. (MATLAB or PHYTON, depending on the availability at the Computer Centre)

Lectures:

1 Lecture : Introduction to supervised and unsupervised learning, examples. Underlying optimization problem: definition of the minimization problem and difficulties (overfitting).

2 Lecture : Basic supervised learning algorithms: linear least squares and solution methods: direct methods and iterative methods: gradient descent. Pre-processing of data. Evaluation of the trained model.

3 Lecture : Linear dimensionality reduction: principal component analysis. Multi-dimensional scaling.

4 Lecture : Neural networks: feed-forward neural networks, activation functions, layers, weights, training the neural network. Stochastic gradient descent method.

Project:

A small supervised learning problem, for example: estimation of the risk of disease from patient data. Or, implement a two-layer fully connected feed-forward neural network.

References:

[1] B. Bohn, J. Garcke, M. Griebel, Algorithmic Mathematics in Machine Learning, SIAM, 2024.

[2] C. F. Higham, D. J. Higham, Deep Learning, An Introduction for Applied Mathematicians, SIAM Review, vol.61,#4, 2019.

[3] A. C. Mueller, S. Guido, Introduction to Machine Learning with Phyton, O' Reilly, 2017.

1[4] A. Ng, Machine learning yearning, online course 2018.