Machine Learning for Physicists

Course proposal – Master of Science in Aeronautics and Space

10 h

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Language: This course may be given in English depending on the audience.

In recent years, Machine Learning methods have become increasingly important in many areas of Physics. This is mainly due to three reasons: an unprecedented abundance of data, considerable computational power associated with remote platforms (cloud computing), and freely available libraries written in Python. The objective of this introductory course on Machine Learning is to show that many problems at the heart of our disciplinary issues can be addressed by generic approaches. Machine learning is classically divided into three branches: supervised learning methods, unsupervised learning methods and reinforcement learning methods, see figure. We will illustrate each of these branches with emblematic techniques.

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1/ Introduction.

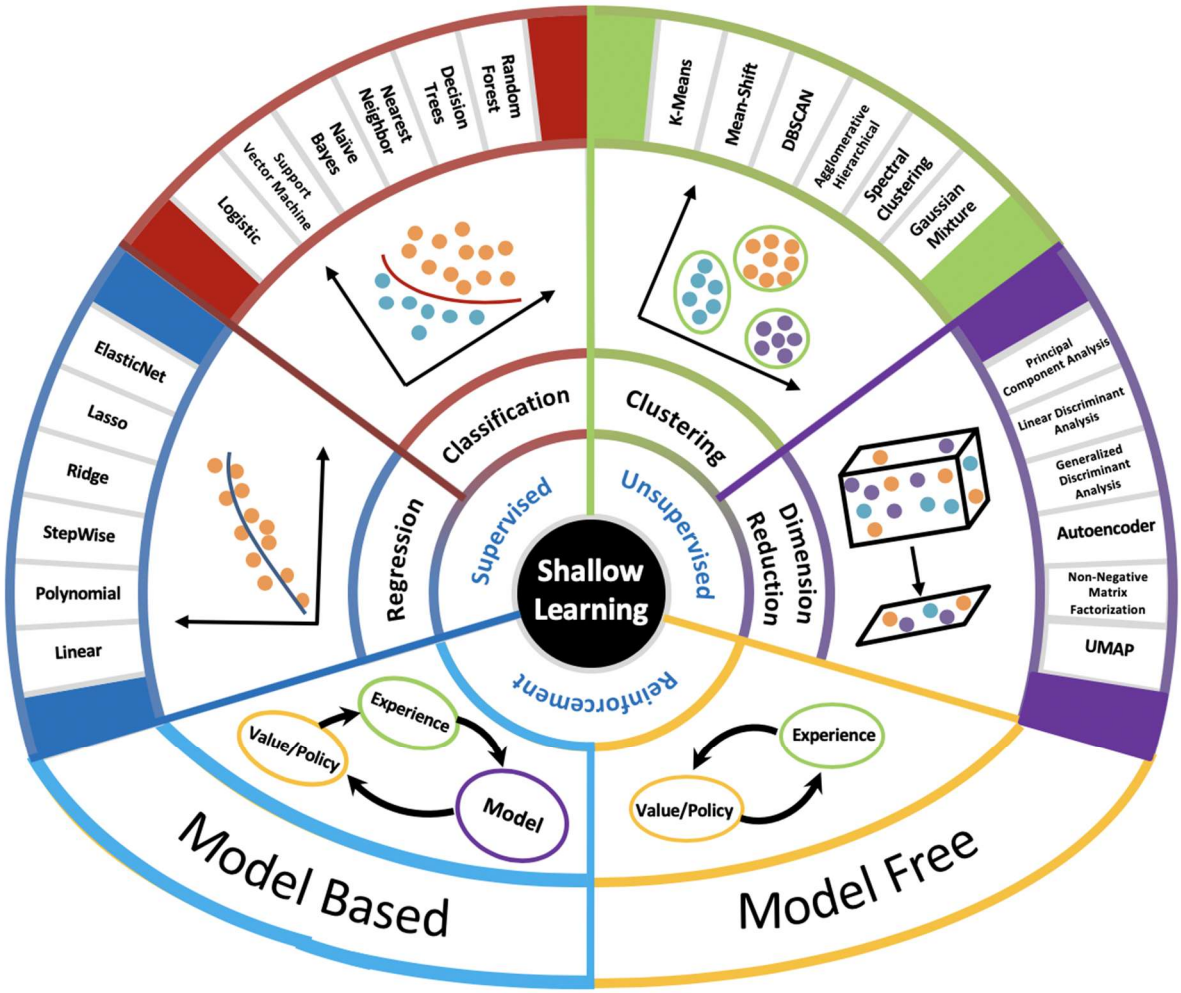
2/ Preliminaries
- 2.1/ Gradient algorithms (Newton, stochastic gradient)
- 2.2/ Neural networks
- 2.3/ Backpropagation algorithm

3/ Supervised methods
- 3.1/ Regression:
  - -- Linear, polynomial, Ridge, LASSO, Elastic Net
- 3.2/ Classification:
  - -- Logistic regression, Bayesian inference

4/ Unsupervised methods
- 4.1/ Clustering:
  - -- K-means, spectral clustering
- 4.2/ Dimensionality reduction:
  - -- Principal Component Analysis, AutoEncoder, Multidimensional Scaling

5/ Reinforcement learning
- 5.1/ Principle
- 5.2/ Application to the control of the Lorenz system

We will illustrate the methods as much as possible with Jupyter notebooks or Python programs.



Classification of machine learning methods.

Calendrier

Date, horaire	Salle
Mercredi 25 Novembre 17h30-19h30	B139 ENSMA
Mercredi 02 Décembre 17h30-19h30	B139 ENSMA
Vendredi 04 Décembre 17h30-19h30	B139 ENSMA
Mercredi 09 Décembre 17h30-19h30	B139 ENSMA
Vendredi 11 Décembre 17h30-19h30	B139 ENSMA