Master's Department of Engineering Sciences

Name of the unit: Introduction to Machine Learning

Lecturer: Catherine ACHARD (catherine.achard@sorbonne-universite.fr)
Course code: UM4RBI10-IntroML
Student workload: 14h of lectures, h of tutorial sessions, 14h of lab sessions@
Credits: 3 ECTS

Specialization tracks:	- **E3A** :	☒ CIMES	☒ Syscom	☒ IPS
	- **AR** :	☒ ROBOT	☒ SI	☒ MeDH
	- **MECA** :	☐ MS2	☐ MF2A	☐ CompMech
		☐ ACOU	☐ EE	☐ EE APP

Semester offered: ☒ S1 ☐ S2 ☐ S3 ☐ S4
Language of instruction: ☒ French ☐ English
Targeted audience: ☒ Engineering Sciences students ☐ Other (specify):
Localization : ☒ PMC Campus ☐ Other (specify):

Course Overview

This course introduces the concepts and methods of machine learning. The teaching aims to give students the technical and methodological mastery of the entirety of a learning problem: from the acquisition and preparation of data, the learning of a model, to the evaluation of the models and the interpretation of the results resulting from this evaluation.
Keywords: Machine learning. Regression and classification problems. Supervised and unsupervised learning. ACP. KPPV. Random forest. Bayesian classification. SVM. Neural networks. Data preparation. Evaluation methodology.

Prerequisites

Students should have previously acquired the following prerequisites to follow this course:

- Mathematics: linear algebra, vector and matrix analysis, functions of several variables
- Computer science: programming (in Python: numpy, etc.), algorithms

Intended Learning Outcomes

By the end of this course, students will be able to:

1. Analyze a problem: Identify the right paradigm for the task and the data
2. Analyze a problem: Choose an algorithm that is appropriate for the task, the data, and the resources
3. Design: Sizing a Model
4. Design: Specify meta parameters to optimize the training of a model's parameters
5. Implementation: Use advanced deep learning design environments (language, api, ide, hardware) to implement a model implementation
6. Implementation: Preparing data for training
7. Evaluation: Develop an adequate experimental protocol to evaluate the performance of a model
8. Evaluation: Monitor and interpret the results obtained to ensure optimal learning

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C1	C1 - Intro, coding, covariance matrix, ACP, LDA, feature selection		AAV 1
S2	C2 / TP1	C2 - Formalism of a learning problem, performance of a classifier, KPPV and Mahalanobis distance TP1 - ACP		AAV 1, 2
S3	C3 / TP2	C3 - Random Forest, Bayesian Classification, Estimation of DDPs TP2 - KPPV with test on 2 unformatted images		AAV 1, 2, 5, 6, 7
S4	C4 / TP3	C4 - SVM TP3 - ROC Curve		AAV 1, 2, 5, 6, 7
S5	C5 / TP4	C5 - Regression, Unsupervised Classification TP4 - Random forest		AAV 1, 2, 3, 4, 8
S6	C6 / TP5	C6 - Introduction to Neural Networks: From MLP to CNN TP5 - Error bias/variance, performance measurement on pre-trained models		AAV 1, 2, 3, 4, 5
S7	C7 / TP6	C7 - Classical neural architectures, attention processes, application to U-Net segmentation TP6 - SVM		AAV 1, 2, 3, 4, 5
S8	TP7	TP7 - Neural Networks		AAV 1, 2, 3, 4, 5, 6, 7

* C/TD/TP respectively corresponds to lectures, tutorials and lab sessions.

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
S4	Individual	In-person	Written	AAV 1- 8	30 %
S10	Individual	In-person	Written	AAV 1- 8	30 %
S10	Individual	In-person	Practical	AAV 1- 8	20 %
S10	Individual	In-person	Practical	AAV 1- 8	20 %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
2	Individual	In-person	Written	AAV 1-8	60 %
1	Individual	In-person	Practical	AAV 1-8	40 %

Date of generation of this unit description: January 14, 2026