UCLouvain

linma2474

2026

High-Dimensional Data Analysis and Optimization

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Absil Pierre-Antoine ;Jacques Laurent ;Massart Estelle ;Nunes Grapiglia Geovani ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	Training in optimization (LINMA2471 level) and matrix calculation (LINMA2380 level).
Main themes	This course is dedicated to the analysis and optimization of high-dimensional data (“High-Dimensional Data Analysis and Optimization”). It addresses the following themes: solving regularized inverse problems, optimization on differential or derivative-free varieties, stochastic optimization methods for machine learning, and sketching and random projection methods.
Learning outcomes	**At the end of this learning unit, the student is able to :** With regard to the AA standard, this course contributes to the development, acquisition and evaluation of the following learning outcomes: · AA1.1, AA1.2, AA1.3 · AA2.1, AA2.2 · AA5.5 More precisely, at the end of the course, the student will be able to: · analyze in depth various methods and algorithms for the numerical computer resolution of scientific or technical problems, for the analysis and optimization of high-dimensional data. Transversal learning outcomes: · Introduction to certain disciplines of applied mathematics (differential geometry, statistics, measurement concentration theory) and description of their use for the analysis and design of data processing algorithms (multidisciplinary approach). · Implementation of algorithms in the Python ecosystem.
Evaluation methods	· Work carried out during the term: homework, exercises, mini-project or practical work. These activities are therefore only organized (and evaluated) once per academic year. · Written or oral exam depending on the circumstances. The final grade is (3/10) T + (7/10) E, where T is the grade for the work completed during the semester and E is the grade for the exam. Any violation of the instructions provided on Moodle, for any activity, may lead to a global grade T = 0. More information is provided on Moodle.
Teaching methods	· Audience lessons · Homework, exercises or practical work under the supervision of assistants
Content	The following elements will be integrated into the course content, with variations from one year to the next depending on the teaching team: · inverse problem solving, regularization by parsimonious and low-rank models, and applications · analysis and processing of high-dimensional data or available in large quantities, · sketching approaches, random projections, randomized principal component analysis · the Nystrom method, and high-dimensional linear algebra · optimization without derivatives or on differential varieties · deep machine learning, stochastic gradient descent, and the Adam method.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=893
Bibliography	Livres et articles de références disponibles gratuitement et référencés sur Moodle Books and reference articles available free of charge and referenced on Moodle
Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemical and Materials Engineering	KIMA2M	5		
Master [120] in Civil Engineering	GCE2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Mechanical Engineering	MECA2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Physical Engineering	FYAP2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Energy Engineering	NRGY2M	5		