UCLouvain

linma2471

2023

Optimization models and methods II

5.00 credits	30.0 h + 22.5 h	Q1

Teacher(s)	Glineur François ;Nunes Grapiglia Geovani ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	A basic optimization course (such as LINMA1702) and basic knowledge in real analysis and linear algebra (such as provided by LEPL1101 and LEPL1102)
Main themes	Linear optimization, convex optimization (including structured conic optimization) ; duality and applications ; interior-point methods ; first-order methods ; trust-region methods ; use of a modeling language.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 Learning outcomes: AA1.1, AA1.2, AA1.3 AA2.1, AA2.2, AA2.4, AA2.5 AA5.3, AA5.5 More specifically, at the end of the course the student will be able to : • recognize the possiblity of formulating or converting a problem into a linear, convex or conic optimization program • exploit the concept of duality in order to understand a problem, produce optimality or impossibility certificates, carry out sensitivity analysis or formulate robust problems • describe, analyze and implement advanced algorithms to solve linear, convex or non-linear optimization problems • use a modeling language to formulate and solve optimization problems, while understanding and exploiting the formal separation between model, data and resolution algorithm Transversal learning outcomes : • use a numerical/computational software tool such as MATLAB, or a modeling language such as AMPL • formulate, analyze and solve optimization models, in a small group • write a report about the formulation, analysis and resolution of optimization models, in a small group
Evaluation methods	Students are assessed individually with a written exam organized during the session, based on the learning outcomes listed above. In addition, students complete a series of homework assignments in small groups during the first term. The grade of the homework is acquired for all the sessions of the academic year (it is not possible to redo the homework assignments in the second session). The final grade is awarded on the basis of the homework assignments (8 points out of 20) and the exam (12 points out of 20). All external sources of information used in the writing of assignments must be cited in accordance with bibliographic referencing standards. The use of generative artificial intelligence is permitted, but must be clearly indicated (specify concerned passages and usage, e.g. information retrieval, text drafting, text correction). Authors remain responsible for the content of their work.
Teaching methods	The course is comprised of lectures, exercise sessions and computer labs, as well as a series of homework assignments to be carried out in small groups.
Content	***Models:*** Advanced modeling techniques for linear and convex optimization ; structured conic optimization ; convex duality with applications (alternatives, sensitivity analysis and robust optimization) ; Lagrangian duality ***Methods:*** path-following interior-point methods for convex optimization (self-concordant barriers) ; first-order methods for convex and non-convex optimization (including stochastic methods) ; algorithmic complexity and convergence rates ; introduction to the AMPL modeling language. Applications in various domains, such as data analysis, machine learning, finance, shape or structural optimization (mechanics), telecommunications, etc.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=1415

Bibliography	• *Convex Optimization*, Stephen Boyd et Lieven Vandenberghe, Cambridge University Press, 2004. • *Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications*, Aharon Ben-Tal, Arkadi Nemirovski, SIAM 2001. • *Interior point methods for linear optimization*, Cornelis Roos, Tamas Terlaky, Jean-Philippe Vial, Springer, 2006. • *Introductory Lectures on Convex Optimization: A Basic Course*, Yurii Nesterov, Kluwer, 2004. • *Lectures on Convex Optimization*, Y. Nesterov, Springer, 2018
Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Mathematics	MATH2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		