UCLouvain

linma2471

2019

Optimization models and methods II

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h + 22.5 h	Q1

Teacher(s)	Glineur François ;
Language :	English
Place of the course	Louvain-la-Neuve
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.
Aims	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 - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Students will be evaluated with an individual written exam, based on the above-mentioned objectives. Students also carry out a series of homeworks in small groups, which are taken into account for the final grade.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The course is comprised of lectures, exercise sessions and computer labs, as well as a series of homeworks 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 ; trust-region methods ; 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	Course documents (notes, slides, exercises and homeworks) are available on Moodle : https://moodleucl.uclouvain.be/course/view.php?id=8194

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. • *Trust-region methods*, A. Andrew R. Conn, Nicholas I. M. Gould, Ph. Philippe L. Toint, SIAM, 2000. • *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	Aims
Master [120] in Data Science Engineering	DATE2M	5		
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 Mathematical Engineering	MAP2M	5		
Master [120] in Statistic: General	STAT2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		