UCLouvain

linma2460

2019

Optimization : Nonlinear programming

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	Q2

Teacher(s)	Nesterov Yurii ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	• General nonlinear optimization. • Smooth and non-smooth convex optimization. • Interior-point methods.
Aims	Learning outcomes: • AA1.1, AA1.2, AA1.3 • AA2.1 • AA5.2, AA5.3 After this course, the student will be able to : 1. Estimate the actual complexity of Nonlinear Optimization problems. 2. Apply lower complexity bounds, which establish the limits of performance of optimization method. 3. Explain the main principles for constructing the optimal methods for solving different types of minimization problems. 4. Use the main problem classes (general nonlinear problems, smooth convex problems, nonsmooth convex problems, structural optimization ' polynomial-time interior-point methods). 5. Understand the rate of convergence of the main optimization methods. 6. Two testing computer projects give a possibility to compare the theoretical conclusions and predictions with real performance of minimization methods Additional benefits : • Training in scientific English • Experience in solving difficult nonlinear optimization problems 1 - - - - *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.** In the written exam (in English or French) there are four questions, one for each chapter of the course (up to 5 points for each question). The marks for the exam and the exercises are combined in the final mark.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The course is given in 12-15 lectures. The computer projects are implemented by the students themselves with supporting consultations.
Content	• General problem of nonlinear optimization. Black-box concept. Iterative methods and analytical complexity. Gradient method and Newton method. Local complexity analysis. • Convex optimization: convex sets and functions; minimization of differentiable and non-differentiable convex functions; lower complexity bounds; optimal methods. • Interior-point methods: notion of self-concordant functions and barriers; path-following methods; structural optimization.
Inline resources	The full syllabus (in English) can be downloaded from the web page of the course.
Bibliography	• Yu.Nesterov. "Introductory lectures on convex optimization. Basic course", Kluwer 2004 • P. Polyak, « Introduction in optimization », J. Willey & Sons, 1989 • Yu. Nesterov, A. Nemirovsky, « Interior-point polynomial algorithms in nonlinear optimization », SIAM, Philadelphia, 1994.

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 Mathematical Engineering	MAP2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		