UCLouvain

linma2460

2024

Optimization : Nonlinear programming

5.00 credits	30.0 h + 22.5 h	Q2

Teacher(s)	Nunes Grapiglia Geovani ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Basic knowledge of Nonlinear Analysis and Linear Algebra. The target audience is the students interested in scientific computing, machine learning and optimization in engineering.
Main themes	• General nonlinear optimization. • Smooth and non-smooth convex optimization. • Interior-point methods.
Learning outcomes	**At the end of this learning unit, the student is able to :** 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
Evaluation methods	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	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	https://moodle.uclouvain.be/course/view.php?id=5537 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	Learning outcomes
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		