



5 crédits	30.0 h + 22.5 h	Q2
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Enseignants	Nesterov Yurii ;
Langue d'enseignement	Anglais
Lieu du cours	Louvain-la-Neuve
Préalables	Basic knowledge of nonlinear analysis and linear algebra. The target audience is the students interested in scientific computing, machine learning and optimization in engineering.
Thèmes abordés	<ul style="list-style-type: none"> <li>• General nonlinear optimization.</li> <li>• Smooth and non-smooth convex optimization.</li> <li>• Interior-point methods.</li> </ul>
Acquis d'apprentissage	<p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>• AA1.1, AA1.2, AA1.3</li> <li>• AA2.1</li> <li>• AA5.2, AA5.3</li> </ul> <p>After this course, the student will be able to :</p> <ol style="list-style-type: none"> <li>1. Estimate the actual complexity of Nonlinear Optimization problems.</li> <li>2. Apply lower complexity bounds, which establish the limits of performance of optimization method.</li> <li>3. Explain the main principles for constructing the optimal methods for solving different types of minimization problems.</li> <li>4. Use the main problem classes (general nonlinear problems, smooth convex problems, nonsmooth convex problems, structural optimization ' polynomial-time interior-point methods).</li> <li>5. Understand the rate of convergence of the main optimization methods.</li> <li>6. Two testing computer projects give a possibility to compare the theoretical conclusions and predictions with real performance of minimization methods</li> </ol> <p>Additional benefits :</p> <ul style="list-style-type: none"> <li>• Training in scientific English</li> <li>• Experience in solving difficult nonlinear optimization problems</li> </ul> <p>-----</p> <p><i>La contribution de cette UE au développement et à la maîtrise des compétences et acquis du (des) programme(s) est accessible à la fin de cette fiche, dans la partie « Programmes/formations proposant cette unité d'enseignement (UE) ».</i></p>
Modes d'évaluation des acquis des étudiants	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.
Méthodes d'enseignement	The course is given in 12-15 lectures. The computer projects are implemented by the students themselves with supporting consultations.
Contenu	<ul style="list-style-type: none"> <li>• General problem of nonlinear optimization. Black-box concept. Iterative methods and analytical complexity. Gradient method and Newton method. Local complexity analysis.</li> <li>• Convex optimization: convex sets and functions; minimization of differentiable and non-differentiable convex functions; lower complexity bounds; optimal methods.</li> <li>• Interior-point methods: notion of self-concordant functions and barriers; path-following methods; structural optimization.</li> </ul>
Ressources en ligne	The full syllabus (in English) can be downloaded from the web page of the course.
Bibliographie	<ul style="list-style-type: none"> <li>• Yu.Nesterov. "Introductory lectures on convex optimization. Basic course", Kluwer 2004</li> <li>• P. Polyak, « Introduction in optimization », J. Willey &amp; Sons, 1989</li> <li>• Yu. Nesterov, A. Nemirovsky, « Interior-point polynomial algorithms in nonlinear optimization », SIAM, Philadelphia, 1994.</li> </ul>

Faculté ou entité en charge:	MAP
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<b>Programmes / formations proposant cette unité d'enseignement (UE)</b>				
Intitulé du programme	Sigle	Crédits	Prérequis	Acquis d'apprentissage
Master [120] : ingénieur civil en science des données	DATE2M	5		
Master [120] : ingénieur civil en mathématiques appliquées	MAP2M	5		
Master [120] en science des données, orientation technologies de l'information	DAT12M	5		