



5.00 crédits

30.0 h + 22.5 h

Q2

Enseignants	Nunes Grapiglia Geovani ;
Langue d'enseignement	Anglais > Facilités pour suivre le cours en français
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><b>A la fin de cette unité d'enseignement, l'étudiant est capable de :</b></p> <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> <ul style="list-style-type: none"> <li>• estimate the actual complexity of Nonlinear Optimization problems;</li> <li>• apply lower complexity bounds, which establish the limits of performance of optimization method;</li> <li>• explain the main principles for constructing the optimal methods for solving different types of minimization problems;</li> <li>• use the main problem classes (general nonlinear problems, smooth convex problems, nonsmooth convex problems, structural optimization, polynomial-time interior-point methods);</li> <li>• understand the rate of convergence of the main optimization methods;</li> <li>• two testing computer projects give a possibility to compare the theoretical conclusions and predictions with real performance of minimization methods.</li> </ul> <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>
Modes d'évaluation des acquis des étudiants	75% de la note finale est déterminée par un examen écrit, et 25% par un devoir.
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	<a href="https://moodle.uclouvain.be/course/view.php?id=5537">https://moodle.uclouvain.be/course/view.php?id=5537</a> 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 mathématiques appliquées	MAP2M	5		
Master [120] : ingénieur civil en science des données	DATE2M	5		
Master [120] en science des données, orientation technologies de l'information	DAT12M	5		