


5.0 crédits

30.0 h + 22.5 h

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| Enseignants:                                  | Nesterov Yurii ;   |
| Langue d'enseignement:                        | Anglais  |
| Lieu du cours                                 | Louvain-la-Neuve   |
| Ressources en ligne:                          | The full syllabus (in English) can be downloaded from the web page of the course.  |
| Préalables :                                  | Basic knowledge of nonlinear analysis and linear algebra.<br>The target audience is the students interested in scientific computing, machine learning and optimization in engineering.   |
| Thèmes abordés :                              | --<br>General nonlinear optimization.<br>--<br>Smooth and non-smooth convex optimization.<br>--<br>Interior-point methods.   |
| Acquis d'apprentissage                        | Learning outcomes:<br>--<br>AA1.1, AA1.2, AA1.3<br>--<br>AA2.1<br>--<br>AA5.2, AA5.3<br>After this course, the student will be able to :<br>--<br>Estimate the actual complexity of Nonlinear Optimization problems.<br>--<br>Apply lower complexity bounds, which establish the limits of performance of optimization method.<br>--<br>Explain the main principles for constructing the optimal methods for solving different types of minimization problems.<br>--<br>Use the main problem classes (general nonlinear problems, smooth convex problems, nonsmooth convex problems, structural optimization ' polynomial-time interior-point methods).<br>--<br>Understand the rate of convergence of the main optimization methods.<br>--<br>Two testing computer projects give a possibility to compare the theoretical conclusions and predictions with real performance of minimization methods<br>Additional benefits :<br>--<br>Training in scientific English<br>--<br>Experience in solving difficult nonlinear optimization problems<br><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> |
| 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 :                                     | --<br>General problem of nonlinear optimization. Black-box concept. Iterative methods and analytical complexity. Gradient method and Newton method. Local complexity analysis.   |

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|  | <p>--<br/>                 Convex optimization: convex sets and functions; minimization of differentiable and non-differentiable convex functions; lower complexity bounds; optimal methods.<br/>                 --<br/>                 Interior-point methods: notion of self-concordant functions and barriers; path-following methods; structural optimization.</p>   |
| <p><b>Bibliographie :</b></p>              | <p>--<br/>                 Yu.Nesterov. "Introductory lectures on convex optimization. Basic course", Kluwer 2004<br/>                 --<br/>                 P. Polyak, « Introduction in optimization », J. Willey &amp; mp; Sons, 1989<br/>                 --<br/>                 Yu. Nesterov, A. Nemirovsky, « Interior-point polynomial algorithms in nonlinear optimization », SIAM, Philadelphia, 1994.</p> |
| <p><b>Faculté ou entité en charge:</b></p> | <p>MAP</p>   |

| <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       | -         |  |