UCLouvain

mqant1329

2021

OPTIMIZATION

5.00 credits	30.0 h + 15.0 h	Q1

Teacher(s)	Catanzaro Daniele ;
Language :	English
Place of the course	Mons
Prerequisites	• MQANT1110 - Mathématiques de gestion 1 • MQANT1227 - Mathématiques de gestion 2 *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	**Part I (Continuous Optimization):** Continuity, differentiability in n dimension, conditions for differentiability, necessary conditions for optimality, convex sets, convex functions, convex optimization problems, Lagrangian duality, descent methods, rudiments of smooth and non-smooth nonlinear optimization; **Part II (Discrete Optimization):** Introduction to integer and combinatorial optimization; formulations; optimality, relaxations, and relationships among relaxations; well-solved problems; matchings and assignments; branch and bound;
Learning outcomes	**At the end of this learning unit, the student is able to :** This course contributes to develop the following competencies : • Knowledge • Scientific reasoning and systematic approach 1 Study limits, continuity, directional derivatives and differentiability for functions of several variables. Locate and identify free extrema of a function; locate extrema under constraints of a function using the technique of Lagrange multipliers. Understand and learn the foundations of continuous and discrete optimization and the main computing techniques to tackle an optimization problem.
Evaluation methods	Students are assessed individually by means of an exam that consists of two parts: 1. An evaluation of the applied modeling skills, which is usually carried out during the last session of the exercizes and which focuses on the Mosel programming language as well as on the ability to model given toy problems. This part is carried out only once per year and the participation is mandatory for all of the students. A poor score on this part precludes the access to the second part (see point 2). 2. An evaluation of the theoretical skills of the students, carried out by means of a written exam during the standard examination sessions. In the case of a red code due to the COVID crisis, an oral will replace the written exam mentioned in point 2.
Teaching methods	Slided, Blackboard lectures, and Excercises in the Computing room.
Content	This course, taught in English, introduces to the foundations of integer programming and combinatorial optimization as well as to the main computing techniques used to model and solve practical discrete optimization problems enojoying partitioning, coloring, routing, telecommunications, location, sustainable logistics and supply chain management features. Particularly emphasis is given to the development of problem solving skills as well as to the digitalization aspects, including among others, the ability to transform mathematical formulations of real problems into computer programs able to solve them. Table of Contents: Mathematical Preliminaries; Fundamental problems in linear algebra and number theory; Optimizing over diophantine inequalities with positivity constraints; Optimality, relaxations families and relationships among relaxations, and type of bounds; Efficiently solvable combinatorial optimization problems; Rudiments of computational complexity; General solution approach to optimization over integers; Introduction to polyhedral combinatorics; Branch-and-cut; Fundations of the Mosel programming language and applications.
Inline resources	Online resources are posted exclusively in the official channel of the course on Microsoft Teams.

Bibliography	The lectures will be integrated with some capita selecta from the following references: (1) S. Boyd and L. Vandenberghe. Convex Optimization. Cambridge University Press 2004. (2) L. A. Wolsey. Integer Programming. Wiley Interscience, 1988. (3) M. Conforti, G. Cornuejols, G. Zambelli. Integer Programming. Springer, 2014. (4) Bagirov, M. Karmitsa and M. M. Mäkelä. Introduction to non smooth optimization. Springer 2014. (5) F. F. Clarke. Optimization and nonsmooth analysis, Siam 1987.
Faculty or entity in charge	CLSM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor : Business Engineering	INGM1BA	5	MQANT1227	🔍