UCLouvain

linma2450

2019

Combinatorial optimization

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h + 22.5 h	Q1

Teacher(s)	Delvenne Jean-Charles (coordinator) ;Hendrickx Julien ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	The course is about different ways to solve optimization problems with discrete or integer variables, which are used to handle indivisibilities, or on/off decisions, such as choosing an edge in a graph, buying a machine, using a warehouse, etc. Such problems arise in scheduling trains or aircraft, constructing a tour in a graph, drawing up a production plan for electricity generation, etc. The theory involves the study of polyhedra, matrices, graphs and aspects of complexity and the development of tight formulations. The algorithmic approaches covered include implicit enumeration and cutting planes (branch-and-cut), Lagrangian relaxation, dynamic programming and approximation algorithms.
Aims	Learning outcomes: • AA1: 1,2 More specifically, at the end of the course, the student should be able to : 1 • formulate different combinatorial problems as integer programmes • explore different formulations for a same problem • find lower and upper bounds to the solution of an integer programme • recognize and solve some integer programmes that are solvable in polynomial time • recognize some integer programmes that are hard to solve (NP-hard) • apply various techniques (branch-and-bound, Lagrangian relaxation, heuristics) to solve hard problems approximately Tranversal learning outcomes: • Use of Matlab or other softwares to solve medium-size problems - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Written exam.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** An exercise session is held approximately every two weeks. One or several home exercises on a software (Matlab or other) will be proposed as well.
Content	1. Formulation of combinatorial optimization and integer programming problems. 2. Finding bounds on the optimal value and using them to prove optimality 3. Recognizing and solving certain easy problems - network flows, trees, matching and assignment problems 4. Introduction to the distinction between easy and hard problems: NP-hardness 5. Intelligent enumeration - the branch-and-bound algorithm 6. Lagrangian relaxation 7. Introduction to cutting plane algorithms 8. Heuristic methods to find good solutions quickly
Inline resources	http://icampus.uclouvain.be/claroline/course/index.php?cid=LINMA2450
Bibliography	Integer Programming, L.A. Wolsey, Wiley, New York 1998.

Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Mathematics	MATH2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		