Anno Accademico 2022/2023

OPERATIONS RESEARCH	
Enrollment year	2022/2023
Academic year	2022/2023
Regulations	DM270
Academic discipline	
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (01/03/2023 - 09/06/2023)
ECTS	9
Lesson hours	80 lesson hours
Language	English
Activity type	ORAL TEST
Teacher	GUALANDI STEFANO (titolare) - 9 ECTS
Prerequisites	This course is an applied math course dedicated to math and engineering students. The students of this course should have followed the fundamental courses in programming, analysis, and linear algebra.
Learning outcomes	The course is a comprehensive introduction to the theory, models, and algorithms of mathematical optimization. The goals of this course are the following: 1. To present students with knowledge of the state-of-the-art of theory and practice of solving optimization problems. 2. To help each student develop his or her own intuition about modeling and solving large-scale real-world problems using optimization software.
Course contents	Part I: Optimization Modeling Optimization modeling is the skill of reducing a messy computational or

engineering problem to a mathematical form that can be solved by using optimization software. By recognizing mathematical patterns in real-world problems, students will develop an intuition for which problems are solvable using optimization modeling techniques and gain the knowledge and skills to then solve them.

Part II: Network flows

Network flow problems form a subclass of linear programming problems with several applications. This part of the course will focus on key special cases of network flow problems including the following: the shortest path problem, the maximum flow problem, the minimum cost flow problem.

Part III: Linear Optimization

The topics in linear optimization include: The Simplex Method, Duality Theory, Sensitivity Analysis, Interior-Point Methods, Implementation Issues.

Part IV: Integer Optimization

The topics in integer optimization include: Branch and Bound, Cutting Plane Algorithms, Strong Valid Inequalities, Lagrangian Duality, Column Generation Algorithms, Heuristic Algorithms.

Teaching methods	Lectures and Laboratories in Computer Labs.
Reccomended or required readings	Book References (Selected Chapters): • H.P. Williams. Model building in mathematical programming. John Wiley & Sons, 2013. • R. K. Ahuja, T. L. Magnanti, and J. B. Orlin. Network flows, 1988. • D. Bertsimas and J. N. Tsitsiklis. Introduction to Linear Optimization, Athena Scientific, 1997. • D. Bertsimas and R. Weismantel. Optimization over Integers. Belmont, MA: Dynamic Ideas, 2005.
Assessment methods	Oral exam + Project Report
Further information	The course is organized in four parts. During each part, we will use as running examples, large-scale optimization problems currently solved in Computational Biology (e.g., Alignment of Genomic Sequencing, Metabolic Networks, Haplotype Analysis), Transportation Planning and Scheduling (Home Health Care Routing, Nurse Scheduling), and Machine Learning (e.g., Regression, Clustering, Optimal Classification Trees).
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile