



UNIVERSITÀ DI PISA

OPERATIONS RESEARCH

MARIA GRAZIA SCUTELLA'

Anno accademico 2022/23
CdS MATHEMATICS
Codice 072AA
CFU 6

Moduli	Settore/i	Tipo	Ore	Docente/i
RICERCA OPERATIVA	MAT/09	LEZIONI	60	MARIA GRAZIA SCUTELLA'

Learning outcomes

Knowledge

The course will introduce the student to the main mathematical properties and algorithmic approaches of Operations Research, the discipline aiming at formulating and solving mathematical models for decision problems stated in an optimization form. At the end of the course the student will know the mathematical foundations and some relevant solution algorithms for two important classes of "easy" problems, that is Network Flow problems and Linear Programming. Furthermore, she/he will be able to formulate "hard" optimization problems via Integer Linear Programming, and to solve them by exploiting some relevant mathematical properties of this class of problems.

Assessment criteria of knowledge

Through the written and the oral examination. Moreover, a discussion with the students will be stimulated during the lessons, to assess the acquired knowledge also in real time.

Skills

At the end of the course the student will be able to formulate and solve optimization problems belonging to the classes studied in the course, i.e. Linear Programming, Network flow problems and Integer Linear Programming.

Assessment criteria of skills

All the skills will be assessed during the written and the oral examination.

Behaviors

Capabilities of mathematical modelling and solving optimization problems via efficient algorithmic approaches will be achieved.

Assessment criteria of behaviors

All the behaviors will be assessed during the written and the oral examination, and through class exercises.

Prerequisites

A basic knowledge of analysis, geometry and linear algebra is recommended.
Moreover, a basic knowledge of the concepts of algorithm and computational complexity is assumed.

Teaching methods

Teaching methods:



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- Lectures
- Exercises

Syllabus

Problems and models (4 hours)

- Decision problems, optimization problems, feasibility problems
- Examples of optimization problems

Linear Programming (LP) (20 hours)

- LP problems and models
- Geometry of LP: polyhedra and their representation
- Duality theory in LP
- Primal Simplex algorithm with related geometrical interpretation
- Complementary Slackness Theorem
- Dual Simplex algorithm with related geometrical interpretation

Network flow problems (16 hours)

- LP problems and models on networks
- Shortest paths
- Maximum flow
- Minimum cost flow

Integer Linear Programming (ILP) (20 hours)

- Combinatorial Optimization and ILP: problems and models
- Modelling techniques
- Proof of optimality
- Heuristic algorithms
- Relaxations
- Enumerative algorithms

Bibliography

Appunti di Ricerca Operativa, exam exercises (with and without solution): available on the web page of the course.

Suggested:

1. F.S. Hillier, G.J. Lieberman, "Introduzione alla ricerca operativa", Franco Angeli, Milano (1999)
2. Massimo Pappalardo, Mauro Passacantando "Ricerca Operativa", Plus, 2010

Non-attending students info

Please contact the teacher.

Assessment methods

Written exam followed by an oral exam. The written exam, of 3 hours, consists of 6 exercises, and covers all of the topics of the course.

Textbooks and student notes are forbidden during the written exam.

Both the written and the oral exams refer to the topics of the current academic year, also for those students who attended the course in previous years.

The oral exam is performed jointly with the written exam, usually a few days later the date of publication of the results of the written exam.

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