Course guide
2707250 - MSDOP - Modeling and Solving Discrete Optimization Problems

Last modified: 07/07/2026

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.

Degree: MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2017). (Optional subject).
MASTER'S DEGREE IN DATA SCIENCE (Syllabus 2021). (Optional subject).

Academic year: 2026 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer:

Others:

PRIOR SKILLS

Basic Algorithmics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEA1. Capability to understand the basic principles of the Multiagent Systems operation main techniques , and to know how to use them in the environment of an intelligent service or system.
CEA13. Capability to understand advanced techniques of Modeling , Reasoning and Problem Solving, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.

Generical:
CG1. Capability to plan, design and implement products, processes, services and facilities in all areas of Artificial Intelligence.

Transversal:
CT6. REASONING: Capability to evaluate and analyze on a reasoned and critical way about situations, projects, proposals, reports and scientific-technical surveys. Capability to argue the reasons that explain or justify such situations, proposals, etc..

TEACHING METHODOLOGY

For the modeling part, the "flipped classroom" system will be used where students will have to watch videos and do small projects. Class hours will be used to resolve doubts and consolidate knowledge.

For the part of resolution techniques, the classic master class methodology and some class of problems will be used.

LEARNING OBJECTIVES OF THE SUBJECT

1.Ability to model optimally a discrete optimization problem and solve it using the proper tools.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	13,5	12.00
Hours medium group	13,5	12.00
Hours small group	13,5	12.00

Total learning time: 112.5 h

CONTENTS

Modeling combinatorial problems

Description:
We will use the modeling language MiniZinc to model a wide variety o problems. We will cover topics such as modeling linear problems, sets, functions, and how to deal with symmetries, common sub-expressions, etc

Solving with Constraint Programming

Description:
We will cover issues such as Look-ahead, heuristics, local consistency and global constraints

Solving with Propositional Logic (SAT)

Description:
We will cover topics such as Conjunctive Normal Form (CNF), resolution, unit propagation, clause learning.

Solving with integer linear programming

Description:
We will overview the SIMPLEX algorithm and Branch and Bound

ACTIVITIES

Modeling

Specific objectives:
1

Related competencies :
CG1. Capability to plan, design and implement products, processes, services and facilities in all areas of Artificial Intelligence.
CEA13. Capability to understand advanced techniques of Modeling , Reasoning and Problem Solving, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.
CEA1. Capability to understand the basic principles of the Multiagent Systems operation main techniques , and to know how to use them in the environment of an intelligent service or system.
CT6. REASONING: Capability to evaluate and analyze on a reasoned and critical way about situations, projects, proposals, reports and scientific-technical surveys. Capability to argue the reasons that explain or justify such situations, proposals, etc..

Full-or-part-time: 61h
Theory classes: 7h
Practical classes: 7h
Laboratory classes: 7h
Self study: 40h

Constraint Programming

Specific objectives:
1

Related competencies :
CG1. Capability to plan, design and implement products, processes, services and facilities in all areas of Artificial Intelligence.
CEA13. Capability to understand advanced techniques of Modeling , Reasoning and Problem Solving, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.
CEA1. Capability to understand the basic principles of the Multiagent Systems operation main techniques , and to know how to use them in the environment of an intelligent service or system.
CT6. REASONING: Capability to evaluate and analyze on a reasoned and critical way about situations, projects, proposals, reports and scientific-technical surveys. Capability to argue the reasons that explain or justify such situations, proposals, etc..

Full-or-part-time: 19h
Theory classes: 2h
Practical classes: 2h
Laboratory classes: 2h
Self study: 13h

Boolean Satisfiability

Full-or-part-time: 22h
Theory classes: 3h
Practical classes: 3h
Laboratory classes: 3h
Self study: 13h

Integer Linear Programming

Full-or-part-time: 10h 30m
Theory classes: 1h
Practical classes: 1h
Laboratory classes: 1h
Self study: 7h 30m

GRADING SYSTEM

Throughout the course, small projects will be carried out with a combined weight of 20% of the final grade. There will also be a quiz at the beginning of the course, a partial exam and a final exam with a total weight of 80% of the grade

RESOURCES

Hyperlink:
- https://www.minizinc.org/