Course guide
205053 - 205053 - Introduction to Metaheuristics for Optimisation Problems

Last modified: 11/04/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 732 - OE - Department of Management.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2025). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Jose M Sallan

Others:

PRIOR SKILLS

This is an optional course thaught in English, so students need to have a sufficient level of English. Some elemental knowledge on coding is also recommended.

REQUIREMENTS

There are no prerequisites.

TEACHING METHODOLOGY

Through presential classes and proposed exercises, students will learn the basics of metaheuristics, how to apply them to specific optimization problems and develop computational experiences.

LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to introduce students to some metaheuristics used to solve optimization problems, such as genetic algorithms, simulated annealing, tabu search and others. At the end of the course, students should be able to define heuristics for specific problems, code them in R and perform computational experiments to assess algorithm performance.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Module 1: introduction to R for optimization

Description:
The R environment: R and RStudio. Data structures in R. Loops and conditional execution. Functions. R packages. Linking R and C: Rcpp and RcppArmadillo.

Specific objectives:
To learn to use R and RStudio to implement optimization algorithms.

Related activities:
Using R for optimization

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

Module 2: local search heuristics

Description:
Concepts of heuristic, metaheuristic and algorithm.
Local search metaheuristics: hill climbing, simulated annealing and tabu search.
Exploring starting solutions: iterated local search and GRASP.

Specific objectives:
To learn the most common local search metaheuristics: simulated annealing, tabu search, iterated local search and GRASP.
To adapt and tune local search metaheuristics for a specific problem.

Related activities:
To implement a local search heuristic.
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Full-or-part-time: 19h
Theory classes: 7h
Self study : 12h

Module 3: Evolutionary metaheuristics

Description:
Evolutionary metaheuristics: genetic algorithms, memetic algorithms, particle swarm optimization, ant colonies.

Specific objectives:
Learn to adapt, implement and tune an evolutionary metaheuristic to a specific problem.

Related activities:
Implementing an evolutionary heuristic.

Full-or-part-time: 19h
Theory classes: 7h
Self study : 12h

Module 4: computational experiments in optimization

Description:
Experimental evaluation of heuristics: test instances, design of computational experiments, reporting of results.

Specific objectives:
To design, implement and report the experimental evaluation of an heuristic.

Related activities:
Performing a computational experiment.

Full-or-part-time: 19h
Theory classes: 7h
Self study : 12h

GRADING SYSTEM

The grade is obtained with four assignments:
Use of R for optimization: 10%
Coding a local search algorithm for a combinatorial problem: 30%
Coding an evolutionary algorithm for a combinatorial problem: 30%
Performing a computational experiment for a combinatorial problem: 30%

BIBLIOGRAPHY

Basic:
- Glover, Fred; Kochenberger, Gary A. Handbook of metaheuristics [on line]. Boston [etc.]: Kluwer Academic Publishers, cop. 2003 [Consultation: 03/05/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/b101874. ISBN 1402072635.