GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Heuristics and Search Methods (E004153)

Course size *(nominal values; actual values may depend on programme)*

Credits 3.0 **Study time 90 h**

Course offerings in academic year 2025-2026

A (semester 2)	English	Gent
B (semester 2)	Dutch	Gent

Lecturers in academic year 2025-2026

Gautama, Sidharta	TW18	lecturer-in-charge

Offered in the following programmes in 2025-2026	crdts	offering
Bridging Programme Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	3	A
Bridging Programme Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	3	A
Master of Science in Business Engineering(main subject Data Analytics)	3	A
Master of Science in Business Engineering (Double Degree)(main subject Data Analytics)	3	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	3	A
Master of Science in Business Engineering (Double Degree)(main subject Operations Management)	3	A
Master of Science in Business Engineering(main subject Operations Management)	3	A
Master of Science in Industrial Engineering and Operations Research(main subject Sustainable Mobility Analytics)	3	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	3	A
Master of Science in Industrial Engineering and Operations Research	3	B
Master of Science in Photonics Engineering	3	A

Teaching languages

English, Dutch

Keywords

Advanced search methods, optimisation, heuristics, genetic algorithms, tabu search, simulated annealing, constraint programming, local search, neural networks.

Position of the course

This course discusses the most recent developments in the area of non-exhaustive search methods for large and complex search spaces. For most optimization problems encountered in practice, the search space is not convex and contains far too many candidate solutions to enumerate them all in order to find the optimal solution. That is why there is a great need for search methods that crawl through the search space in a more intuitive way, converging very fast to solutions which, although perhaps suboptimal, are still very good. Often, the success of such heuristic methods depends on whether one succeeds in implementing problem-specific knowledge into the search method. In the course, several classes of heuristic approaches are discussed which prove to be extraordinarily successful with some of the hardest realistic problems.

Contents

- Local search methods
- Stochastic local search

- Constraint programming
- Neural networks
- Principles of tabu search
- Genetic algorithms
- Simulated annealing

Initial competences

There are no specific initial competences other than admission to the mentioned master programs

Final competences

1 Being able to describe the different classes of modern search methods and their application areas
2 Having a thorough knowledge of heuristics and approximation methods
3 Awareness of the influence of operators and representation
4 Being able to analyse a solution method in terms of stability and optimality of the solution found
5 Assess the suitability of a specific (class of) search methods for a given problem and suggest better alternatives
6 Independently being able to translate a realistic optimization problem into a mathematical model and assess the feasibility of different search methods
7 Being able to adjust generic methods in order to improve convergence for a given problem
8 Critical assessment of results obtained by different classes of search methods

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture

Extra information on the teaching methods

Students are assigned a project (individually or as group work). The written report and the oral presentation of this project work are the subject of the permanent evaluation.

Study material

Type: Slides

Name: Slides used in the lectures, selected research articles and chapters in books.
Indicative price: Free or paid by faculty
Optional: no

References

Rothlauf F., Design of Modern Heuristics, Principles and Application, Springer 2011.
Morton T.E, Pentico D.W., Heuristic Scheduling Systems with Applications to Production Systems and Project Management, Wiley 1993.

Course content-related study coaching

The lecturers and assistants are available before and after the lectures.

Assessment moments

continuous assessment

Examination methods in case of periodic assessment during the first examination period

Examination methods in case of periodic assessment during the second examination period

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

Continuous evaluation: assessment of the project work, the report and

presentation.

Calculation of the examination mark

Continuous evaluation 100%.