GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Soft Computing (C004552)

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

Credits 6.0 **Study time 165 h**

Course offerings in academic year 2024-2025

A (semester 2) Dutch Gent

Lecturers in academic year 2024-2025

Cornelis, Chris WE02 lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Master of Science in Teaching in Science and Technology(main subject Mathematics)	6	A
Master of Science in Computer Science	6	A
Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Soft computing, computational intelligence, fuzzy sets, rough sets, machine learning

Position of the course

Soft computing is a subfield of artificial intelligence that deals with the development of algorithms and computational techniques inspired by human reasoning and biological systems. In contrast to traditional computer science, which relies on precise mathematical models, soft computing techniques embrace uncertainty, imprecision, and partial truth to solve complex problems. The goal is to mimic the flexibility, adaptability, and learning capabilities of the human mind, making it particularly suitable for tasks involving ambiguity or uncertainty in the data. In this course, we focus on two prominent soft computing techniques: fuzzy sets and rough sets. We explore how they can be combined in a wide range of machine learning applications, such as classification, attribute selection, and rule induction. This course closely aligns with current research.

Contents

1. Basic concepts from fuzzy set theory: membership degrees, logical operations, fuzzy relational calculus
2. Classical rough set theory
2.1 Motivation: inconsistency in nominal data
2.2 Lower and upper approximations
2.3 Attribute selection: reducts
2.4 Variants: dominance-based/covering-based rough sets, variable precision rough sets, ...

3.Fuzzy-rough set theory
3.1 Motivation: inconsistency in numerical data
3.2 Lower and upper approximation
3.3 Attribute selection: fuzzy reducts
3.4 Robust fuzzy-rough sets: based on fuzzy quantifiers, OWA operators, ...
3.5 Classification with fuzzy-rough sets: fuzzy-rough nearest neighbors algorithm
3.6 Various applications: imbalanced data, multi-label data, ...

Initial competences

1. A positive attitude w.r.t. a mathematical approach. Basic notions about fuzzy

sets are introduced at the start of the course.
2. Basic programming skills.

Final competences

1 The students should be familiar with the studied soft computing techniques and be able to apply them to solve machine learning problems.
2 They should be capable of conducting an experimental study on benchmark datasets using the studied techniques and critically evaluate the results.
3 They should be able to initiate independent research in the studied area.

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

Lecture

Extra information on the teaching methods

The learning material is provided in English.
The learning material is electronically available (free of charge), using the Ufora website.

Study material

Type: Slides

Name: Soft Computing
Indicative price: Free or paid by faculty
Optional: no

References

0. Lenz, Fuzzy rough nearest neighbour classification on real-life datasets, PhD thesis, 2023.
M. Palangetic, Machine Learning on Data with Inconsistencies and its Granular Properties, PhD thesis, 2022.
S. Vluymans, Dealing with Imbalanced and Weakly Labelled Data in Machine Learning using Fuzzy and Rough Set Methods, PhD thesis, 2018.

Course content-related study coaching

Students can ask questions during lectures or via e-mail.

Assessment moments

end-of-term and continuous assessment

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

Participation, Presentation, Assignment

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

Project: in a small group, in which the theory is applied to a specific application domain, with oral presentation (both during the course weeks, and at the end) and written report
Participation: presence, participation in discussions during class, preparing/finishing selected exercises (both programming tasks and open questions)

Calculation of the examination mark

The project counts for 10 points out of 20, just like the permanent evaluation. A student should obtain at least 50% for each part to be able to pass.