SYLLABUS

Name: ***Fuzzy Data Analysis (MakAu-DS>SM1FDA19)***
Name in Polish:
Name in English: ***Fuzzy Data Analysis***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau3/course/view.php?id=387

Short description:

The aim of the course is to introduce students to fuzzy set-based methods for data representation, classification, and knowledge discovery. The course focuses on handling uncertainty and imprecision using fuzzy logic and intelligent systems, with particular emphasis on decision support applications. The lecture provides a theoretical foundation and explores practical uses of fuzzy methods in modern AI.

Description:

ECTS credits: 2.

Total workload: 50 hours (30 contact hours, 20 hours of student's individual work).
Types of contact hours:
- lecture: 15 hours,
- project classes: 15 hours.

Student's individual work includes: implementation of a fuzzy reasoning system, report writing, and preparation for tests.

Lecture:
- Introduction: the importance of fuzzy data analysis in data science.
- Fundamentals of fuzzy set theory: key definitions, membership functions, and operations on fuzzy sets.
- Approximate reasoning: inference rules in classical (binary) logic and fuzzy logic; fuzzy implications.
- Basic types of fuzzy systems: overview of Mamdani, Takagi-Sugeno-Kang, and Tsukamoto systems; fuzzy systems with parameterized consequents.
- Expert-defined fuzzy systems: rule bases created using domain expert knowledge; practical examples.
- Automatic knowledge extraction: data-driven methods for generating fuzzy rule bases.
- Fuzzy clustering: algorithms and their applications in data analysis.
- Neuro-fuzzy systems: hybrid approaches combining neural networks and fuzzy logic.

Project:
Students apply concepts learned during the lectures to analyze data, represent uncertainty, and derive fuzzy rules. The project includes:
- identifying and formulating the problem,
- selecting appropriate fuzzy methods and tools,
- implementing a fuzzy inference system,
- preparing complete documentation, including source code, results, and a discussion of conclusions.

Bibliography:

- E. Czogała, J.M. Łęski, Fuzzy and Neuro-Fuzzy Intelligent Systems, Springer, 2000.
- W. Pedrycz, Fuzzy Control and Fuzzy Systems, Research Studies Press, 1993.
- A. Piegat, Fuzzy Modeling and Control, Springer, 2001.
- D. Rutkowska, Neuro-Fuzzy Architectures and Hybrid Learning, Springer-Verlag, 2002.
- L.-X. Wang, A Course in Fuzzy Systems and Control, Prentice Hall, 1997.
- H.J. Zimmerman, Fuzzy Set Theory and Its Applications, Springer, 2001.

Learning outcomes:

At the completion of the course, the student:
- knows the fundamental concepts of fuzzy sets, approximate reasoning, fuzzy systems, and fuzzy clustering (test, final test) - K2A_W01,
- is able to apply appropriate measures of uncertainty and imprecision to develop a decision support tool (project implementation) - K2A_U14,
- is able to extract fuzzy rules from data and evaluate their quality (project report) - K2A_U15,
- is able to relate the problem of uncertainty modeling in specific applications to the formalism of fuzzy sets (project implementation) - K2A_U16.

Assessment methods and assessment criteria:

Students are required to pass the final written test (T) and complete the project assignment (P).

The passing criterion for the final test is achieving a minimum score of 2.75 points, which corresponds to at least 55% correct answers. A student may be exempted from the final test based on quiz results. Quizzes are graded on a scale from 2.0 to 5.0, in 0.5-point increments. To qualify for exemption, the student must obtain at least three grades of 3.0 or higher and achieve an average score of at least 2.75 across all quizzes. Absence during a quiz results in a score of 0.

Project:
Students must prepare and present a project report that includes:
- a description of the problem,
- source code,
- results, discussion and conclusions.

Passing criteria: correct and complete implementation of the project and submission of the project report.

The final grade (FG) is calculated as the average of the final test grade (T) and the project grade (P), according to the formula:
FG = (T + P) / 2.

Final grades are rounded according to the following rules:
[3.00 – 3.25) → 3.0,
[3.25 – 3.75) → 3.5,
[3.75 – 4.25) → 4.0,
[4.25 – 4.75) → 4.5,
[4.75 – 5.00] → 5.0.

The syllabus is valid from academic year 2025/26 and its content cannot be changed during the semester.

Element of course groups in various terms:

Course group description	First term	Last term
missing group description in English (MakAu>SM1-DS-19)	2020/2021-L	
Automation, electronics and informatics sem. 1 (AEIAu>SM_1)	2024/2025-Z	

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	2	2020/2021-L	