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| Course name: Fuzzy systems & uncertain processing | | |
| Field of study: Computer science | Type of study: Full time | Course code: CIDM1_03 |
| Course characteristics: Mandatory within the additional content | Level: Second (M.Sc.) | Year: I Semester: I |
| Type of classes: lectures, laboratories, exercises | Hours per week: 2 lect^E, 2 lab, 1 ex | ECTS points: 5 ECTS |

COURSE GUIDE

AIMS

- A1. Acquainting the student with selected methods of uncertain processing, in particular fuzzy logic, rough sets theory, affine and interval arithmetic.
- A2. Obtaining by the students the practical skills in recognizing the fields when presented methods could be applied.
- A3. Obtaining by the students the practical skills in developing solutions to processing an uncertain data.

PREREQUISITES

1. The basic knowledge in the field of the arithmetic.
2. The basic knowledge in the field of the classic set theory.
3. The skills of working alone and in the group.
4. The skills of correct interpretation and presentation of own activity.

LEARNING OUTCOMES

- EE 1 – Students will possess a depth theoretical knowledge in the field of the fuzzy set theory and fuzzy inference systems.
- EE 2 – Students will possess a basic knowledge in the field of the rough set theory.
- EE 3 – Students will possess a basic knowledge in the field of the affine and the interval arithmetics.
- EE 4 – Students will possess practical skills in developing fuzzy and rough solutions to processing an uncertain data.
- EE 5 – Students will possess an ability to use the affine and the interval arithmetic.
- EE 6 – Students will develop the ability to use literature, databases and other sources in their work.
- EE 7 – Students will develop the ability to work alone and in the team and prepare the report from the work.

CONTENT

| Lectures | | Hours |
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| Lect. 1 | Preface to uncertain processing | 2 |
| Lect. 2 | Fuzzy sets and their properties | 2 |
| Lect. 3 | Triangular norms and operations on fuzzy sets | 2 |
| Lect. 4 | Fuzzy relations and operations on them | 2 |

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| Lect. 5 | Fuzzy reasoning | 2 |
| Lect. 6 | Fuzzy reasoning systems | 2 |
| Lect. 7 | Designing of fuzzy knowledge bases | 2 |
| Lect. 8 | Fuzzy–neuro reasoning systems Flexible Neuro-Fuzzy Systems | 1 1 |
| Lect. 9 | Learning of Fuzzy–neuro reasoning systems | 2 |
| Lect. 10 | Zadeh’s extension principle Fuzzy numbers and fuzzy arithmetic | 1 1 |
| Lect. 11 | Various applications of fuzzy logic Type II fuzzy sets | 1 1 |
| Lect. 12 | Operations on type II fuzzy sets Type II fuzzy reasoning systems | 1 1 |
| Lect. 13 | Rough set theory | 2 |
| Lect. 14 | Applications of rough set theory | 2 |
| Lect. 15 | Preface to affine and interval arithmetic | 2 |
| Exercises | | Hours |
| Ex. 1 | Linguistic variable and their values | 1 |
| Ex. 2 | Properties of fuzzy sets | 1 |
| Ex. 3 | Operations on fuzzy sets | 1 |
| Ex. 4 | Fuzzy relations and operations on fuzzy relations | 1 |
| Ex. 5 | Fuzzy reasoning | 1 |
| Ex. 6 | Advances in fuzzy reasoning | 1 |
| Ex. 7 | Components of fuzzy reasoning systems | 1 |
| Ex. 8 | Developing of fuzzy knowledge bases | 1 |
| Ex. 9 | Fuzzy–neuro reasoning systems | 1 |
| Ex. 10 | Zadeh’s extension principle and fuzzy arithmetic | 1 |
| Ex. 11 | Various applications of fuzzy logic | 1 |
| Ex. 12 | Selected type II fuzzy opeartions | 1 |
| Ex. 13 | Rough sets theory | 1 |
| Ex. 14 | Applications of rough sets | 1 |
| Ex. 15 | Affine and interval arithmetic in practice | 1 |
| Laboratories | | Hours |
| Lab. 1 | Software overview | 2 |
| Lab. 2 | Linguistic variables and fuzzy sets | 2 |
| Lab. 3 | Operations on fuzzy sets and their visualisation | 2 |
| Lab. 4 | Operations on fuzzy relations and their visualisation | 2 |
| Lab. 5 | Fuzzy reasoning | 2 |
| Lab. 6, 7, 8 | Various applications of fuzzy reasoning systems | 6 |
| Lab. 9 | Developing of fuzzy knowledge bases | 2 |
| Lab. 10, 11, 12 | Developing and applications of fuzzy-neuro reasoning systems | 6 |
| Lab. 13, 14 | Data processing using rough sets theory | 4 |
| Lab. 15 | Other methods in uncertain processing | 2 |

TEACHING TOOLS

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| 1. – lectures using multimedia presentations |
| 2. – blackboard and chalk or whiteboards and pens |
| 3. – laboratory guides |
| 4. – reports from laboratory activities |
| 5. – computer stations with software |

LITERATURE

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| Leszek Rutkowski, Computational Intelligence, Springer-Verlag 2010 |
| Leszek Rutkowski, Flexible Neuro-Fuzzy Systems, Kluwer Academic Publishers, 2004 |
| Dimiter Driankov, Hans Hellendoorn, Michael Reinfrank, An Introduction to Fuzzy Control, Springer, 1996 |
| Alireza Sadeghian, Hooman Tahayori (Eds.), Frontiers of Higher Order Fuzzy Sets, Springer, 2014 |
| Kumar S. Ray, Soft Computing and Its Applications, Volume Two: Fuzzy Reasoning and Fuzzy Control, Apple Academic Press, 2014 |

TEACHERS

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ADDITIONAL NOTES

Links to course unit teaching materials can be found on the <http://iisi.pcz.pl/ClaDM/> website for current students.