University of Ostrava
Institute for research and applications of fuzzy modeling

Subject: Report on the trainings in Niš

In the period from 25. 3. to 31. 3. 2022 the contents of the workshop was provided by staff members of University of Ostrava, Czech Republic. The team of instructors consisted of 2 females (prof. Irina Perfilieva, doc. Petra Murinová). The program took place partly in the lecture hall of University of Niš, partly in natural areas of the university campus.

Murinová and Perfilieva attended the training meeting in connection with the ERASMUS + project. We presented four lectures for the master study students and to the teachers as well.

Murinová: 29.3. 2022:

„Introduction to the fuzzy set theory: Motivation, Examples, Discussion“

In the beginning of the lecture, the audience was first introduced to the term fuzzy set. The first goal was to explain where this term originated and for what purpose a group of scientists began to focus on the field of fuzzy set theory.

The audience was presented with an article by prof. Zadeh, who proposed the concept and mathematical definition of a fuzzy set. Another goal was to show the listeners some natural examples of a fuzzy set. Furthermore, the students themselves devoted themselves to the construction of fuzzy sets in order to discuss where these special mathematical functions are used in the real world.

At the end of the lecture, the audience was introduced to areas of applied research where fuzzy sets are used.

Murinová: 31.3. 2022**:**

„LFLC Software (Linguistic fuzzy logic controller): Description, Examples, Discussion“

Linguistic Fuzzy Logic Controller (LFLC), allows to create and modify language descriptions and test their behavior. Both the approximate method is introduced in the program deduction, and fuzzy approximation, i.e. relational interpretation of fuzzy IF-THEN rules. These methods can be used not only in the regulation of a process, but also when approximating a function or solving a decision-making problem that can to characterize with a linguistic description.

Software for regulation with individual types of fuzzy controllers was presented as part of the presentation. The aim was to familiarize the audience with the software developed at the University of Ostrava and to show the individual possibilities of fuzzy regulation. Further, individual examples were presented as well as a link to the website where this software can be downloaded.

Perfilieva: 28.3. 2022: **Introduction to Fuzzy Logic as a Method for Approximate Reasoning**

This talk discussed the prerequisites and applications of fuzzy logic. In particular, the technique of fuzzy transforms was explained and the necessary theoretical details were given. In this regard, the relationship between the fuzzy transform and other well-known integral transforms was discussed. Then two phases were introduced: direct and inverse fuzzy transform and the properties were listed. In the final part, two important applications to image processing were introduced and the role of fuzzy transform was explained in detail. The issue of complexity was also discussed.

After the presentation, the following questions were discussed:

- Is there a software tool for working with the fuzzy transform?
- What are other applications of this methodology?
- What are the known complexity estimates for the proposed applications?

Perfilieva: 29.3. 2022: **Algebras for fuzzy logic: Part I**

The first part of the presentation was focused on the motivation and explanation of how the generalized structures for fuzzy logic were constructed. The main point of the lecture was to explain the construction of the basic algebraic structure, which is the residuated lattice.

In the next part of the presentation, we focused on explaining the basic properties. Furthermore, the main question below were discussed:

- What is a proof in a formal fuzzy logic
- How to estimate the degrees of truth in a fuzzy logic
- In which way lattice-ordered algebras generalize Boolean algebra

Perfilieva: 30.3. 2022: **Algebras for fuzzy logic: Part II**

In the second part of the presentation, we focused on other special logic structures for fuzzy logic. We have shown and discussed the main differences between individual structures mainly from the point of view of expected properties.

In the next part of the presentation we focused on Lattice-ordered algebras with residuated operators. The listeners were particularly introduced to examples of these structures.

Day	Serbia	Albania	Spain

29.3. Murinová	12	10	3
29.3. Perfilieva	12	10	3
31.3. Murinová	6	10	4
30.3. Perfilieva	20	10	4