Strengthening Teaching Competences
in Higher Education
in Natural and Mathematical Sciences

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CPD course - UMB (for submittion)

Professional Development in Mathematical Education

Centre for Continual Professional Development of Teaching Staff

Faculty of sciences and mathematics, UNI

October 2022

Monday
Instructor: Vladimir Janis
Course: Basics of Fuzzy Sets
Duration: 5 hours

In simple terms, a fuzzy set is a set in which the boundaries of its elements are not clearly defined. This means that the membership of an element in the set can be expressed as a degree of membership, which is a value between 0 and 1. For example, a fuzzy set might include the elements "small," "medium," and "large," where the membership of a given object in the set would be determined by how closely it matches these categories. This is in contrast to a classical set, in which the membership of an element is either 0 or 1, depending on whether it belongs to the set or not.
The key topics:

- The concept of a fuzzy set and its properties
- Fuzzy set operations, such as union, intersection, and complement
- The use of membership functions to represent fuzzy sets
- Fuzzy set theory and its applications in decision making and control systems
- The concept of fuzzy logic and its relationship to fuzzy sets
- Methods for defuzzification, or converting fuzzy sets into crisp sets

Tuesday
Instructor: Alzbeta Michalikova
Course: Fuzzy Logic
Duration: 5 hours

Fuzzy logic is a mathematical system that is used to represent and manipulate vague or imprecise statements. It is based on the idea that objects or concepts can have degrees of truth or falsehood, rather than being simply true or false. This allows for more flexible and natural ways of representing and reasoning about uncertain or incomplete information.

Fuzzy logic has a wide range of applications, including in control systems, artificial intelligence, natural language processing, and image and signal processing. It can be used to represent and manipulate vague concepts, such as "hot" and "cold," "near" and "far," and "fast" and "slow," in a way that more closely resembles human thinking.

Fuzzy logic is closely related to fuzzy sets, which are used to represent and manipulate sets of objects or concepts that are not clearly defined. Fuzzy logic extends this concept by defining rules and operations that can be applied to fuzzy sets in order to reason about and manipulate vague or imprecise information.

The basics of fuzzy logic can be summarized as follows:

- Fuzzy logic is a mathematical system that is used to represent and manipulate vague or imprecise statements.
- In fuzzy logic, objects or concepts can have degrees of truth or falsehood, rather than being simply true or false.
- This allows for more flexible and natural ways of representing and reasoning about uncertain or incomplete information.
- Fuzzy logic is based on the concept of a fuzzy set, in which the membership of an element in the set can be expressed as a degree of membership between 0 and 1.
- Fuzzy logic defines rules and operations that can be applied to fuzzy sets in order to reason about and manipulate vague or imprecise information.
- Fuzzy logic has a wide range of applications in fields such as control systems, artificial intelligence, natural language processing, and image and signal processing.

Wednesday
Instructor: Jana Spirkova
Course: Fuzzy Regulation
Duration: 5 hours

Fuzzy regulation is a method of control that uses fuzzy logic to regulate the behavior of a system. It is based on the idea that the control signals used to regulate the system can be expressed as fuzzy sets, rather than crisp numerical values. This allows for a more flexible and natural way of representing and manipulating the control signals, which can make the control system more effective and robust in the presence of uncertainty or noise.

Fuzzy regulation is often used in control systems where the dynamics of the system are complex or poorly understood, or where the system is subject to external disturbances or noise. By using fuzzy logic to represent and manipulate the control signals, the control system can adapt to changing conditions and make decisions based on

imprecise or incomplete information. This can result in more robust and reliable control of the system.

Fuzzy regulation is closely related to other methods of control that use fuzzy logic, such as fuzzy control and neuro-fuzzy control. These methods all use fuzzy logic to represent and manipulate the control signals in order to improve the performance and reliability of the control system.

The basics of fuzzy regulation can be summarized as follows:

- Fuzzy regulation is a method of control that uses fuzzy logic to regulate the behavior of a system.
- In fuzzy regulation, the control signals used to regulate the system are represented as fuzzy sets, rather than crisp numerical values.
- This allows for a more flexible and natural way of representing and manipulating the control signals, which can improve the performance and robustness of the control system.
- Fuzzy regulation is often used in control systems where the dynamics of the system are complex or poorly understood, or where the system is subject to external disturbances or noise.
- By using fuzzy logic to represent and manipulate the control signals, the control system can adapt to changing conditions and make decisions based on imprecise or incomplete information.
- Fuzzy regulation is closely related to other methods of control that use fuzzy logic, such as fuzzy control and neuro-fuzzy control.

Thursday
Instructor: Vladimir Kobza
Course: Fuzzy Control
Duration: 5 hours

Fuzzy control is a type of control system that uses fuzzy logic to determine the appropriate control action. Fuzzy logic is a mathematical system that uses fuzzy set theory to represent imprecise or uncertain information. In a fuzzy control system, the control action is determined by a set of rules that are defined based on the system's inputs and the desired output. These rules are then used by the controller to determine

the appropriate control action. Fuzzy control is commonly used in systems where the
One of the key features of fuzzy control systems is their ability to handle uncertainty and imprecise information. Unlike traditional control systems, which use precise mathematical models to determine the control action, fuzzy control systems use fuzzy set theory to represent imprecise or uncertain information. This allows the system to make decisions based on approximate, rather than exact, values.

Another key feature of fuzzy control systems is their flexibility. Because the rules that determine the control action are defined by the user, the system can be easily adapted to different situations and can be fine-tuned to achieve the desired performance.

Overall, fuzzy control is a powerful tool for designing control systems that can handle complex and uncertain situations. It is commonly used in a wide range of applications, including automated control systems for household appliances, industrial processes, and transportation systems.
relationships between the inputs and outputs are complex or not well-defined, such as in automated control systems for heating and cooling systems, washing machines, and other household appliances.

Friday
Instructor: Miroslav Vybostok
Course: Linguistic Modifiers
Duration: 5 hours

Linguistic modifiers are words or phrases that are used to modify or describe the meaning of other words or phrases. They are commonly used to add additional information or to qualify the meaning of a word or phrase. For example, the word "very" is a linguistic modifier that is used to indicate that something has a high degree of a particular quality. The phrase "kind of" is another linguistic modifier that is used to indicate that something is similar to, but not exactly the same as, something else.

In fuzzy logic, linguistic modifiers are used to represent the degree of truth or falsehood of a statement. For example, a statement such as "the temperature is very cold" can be represented using fuzzy logic by assigning a value to the linguistic modifier "very" that indicates the degree to which the temperature is cold. This value can then be used by the fuzzy control system to determine the appropriate control action.

Overall, linguistic modifiers are an important part of fuzzy logic and fuzzy control systems. They allow these systems to represent and handle imprecise or uncertain information, which is critical in many real-world control applications.

Relational modifiers are words or phrases that are used to indicate the relationship between two things. For example, the word "more" is a relational modifier that is used to indicate that one thing has a greater quantity or degree of a particular quality than another thing. The phrase "less than" is another relational modifier that is used to indicate that one thing has a smaller quantity or degree of a particular quality than another thing.

In fuzzy logic, relational modifiers are used to represent the relationship between two fuzzy sets. For example, the phrase "is more similar to" can be used to indicate that one fuzzy set has a greater degree of similarity to another fuzzy set than some third fuzzy set. This information can then be used by a fuzzy control system to determine the appropriate control action.

Overall, relational modifiers are an important part of fuzzy logic and fuzzy control systems. They allow these systems to represent and handle complex relationships between different concepts, which is critical in many real-world control applications.

Date:----------

Renowned professor ------,

On a basis of the Organisational programme of the Center for professional development of the Faculty of sciences and mathematics on the University of Nis, a commission was formed for the accreditation of a specialist course of continual professional development: "Imprecise information processing", consisting of the following members:

1. Dr Vladimir Janis (head of the comission)
2. Dr Vladimir Kobza
3. Dr Alzbeta Michalikova
4. Dr Jana Spirkova
5. Dr Miroslav Vybostok

We are very delighted that you have accepted to be a part of the accreditation of the course and give your scientific opinion and suggestions to make it even better.

Program of the course is accredited if:
1) it improves the knowledge, skills and competences of the participants;
2) is based on the newest revelations and discoveries in the field;
3) contributes to the improvement on the quality of professional work;
4) has clearly defined themes, target groups and program length.

Keeping in mind that all lecturers are well-experienced university professors, I hope that this review will not take a lot of time and that everyone could submit it until the date: 15. 12. 2022 by sending it via e-mail to: tecomp.p2018@gmail.com.

We kindly ask you to fill the review table, sign the document and send it scanned to the above-mentioned e-mail address.

Thank you for your cooperation and contribution.

Kind regards,

Owner of the specialist course for professional development

Review table:

	Yes/No	Idea for improvement(optional)
The program improves the knowledge, skills and competences of the participants	Yes	
The program is based on the newest revelations and discoveries in the field	Yes	
The program contributes to the improvement on the quality of professional work	Yes	
The program has clearly defined themes, target groups and program length	Yes	

Place: Banska Bystrica, Slovakia

Date: _____

Signature

_____

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