

**Course Number:** CSc 876

**Course Title:** Soft Computing and Decision Support

**Number of Credits:** 3

**Schedule:** Three hours of lecture per week.

**Prerequisite:** CSc 665 or consent of instructor

### **Catalog Description**

CSc 665 or consent of instructor. Fuzzy sets, rough sets, and fuzzy logic. Approximate reasoning. Possibility theory. Fuzzy controllers. Multicriteria decision making. Continuous preference logic. LSP method for evaluation and optimization. Decision engineering methods and applications.

### **Expanded Description**

The goal of this course is to present computing models and techniques that deal with imprecision, uncertainty, partial truth, and approximation, in a way that is similar to processing performed by human mind. Attempts to develop models that are similar to human reasoning resulted in important concepts of fuzzy sets, rough sets, fuzzy logic, possibility theory, preference logic, multicriteria decision models, and many applications based on neural networks, evolutionary computing, machine learning, probabilistic reasoning, etc. The goal of this course is to present selected areas of soft computing in an advanced research-oriented way, following current developments in this dynamic area. In particular, the course will include the following topics:

- **Fuzzy Sets and Fuzzy Logic**
  - Crisp sets and fuzzy sets
  - Alpha-cuts
  - Operations of fuzzy sets
  - t-norms and conorms
  - Fuzzy relations
  - Multivalued logics
  - Fuzzy propositions and quantifiers
  - Linguistic variables and their use
  - Inference in fuzzy systems
  - Information and uncertainty
  - Comparison of fuzzy sets and rough sets
  
- **Applications of Fuzzy Logic**
  - Methods of using expert opinions
  - Fuzzy expert systems
  - Approximate reasoning
  - Design of fuzzy controllers
  - Fuzzy decision making
  - Fuzzy ranking methods

- **Continuous Preference Logic**
  - Partial Truth and Logic Conditions in Evaluation
  - Observable Properties of Human Evaluation Logic
  - Andness and Orness
  - Relative Importance and Weights
  - Graded Conjunction/Disjunction
  - Partial Absorption
  - Compound Preference Logic Functions
  - Nonstationary Criteria
  
- **LSP Method**
  - An Overview of the LSP Method
  - System Attribute Tree
  - Elementary Criteria
  - Logic Aggregation of Preferences
  - Cost/Preference Analysis
  - Reliability Analysis
  - Sensitivity Analysis
  - Tradeoff Analysis
  - System Optimization
  - LSP Software Technology
  
- **Multiple Criteria Decision Analysis**
  - Preference modeling
  - Utility theory
  - Value function methods
  - The analytic Hierarchy Process
  - Outranking methods
  - Applications of MCDA methods

### **Method of Evaluation**

Student learning will be evaluated on the basis of completeness and quality of project assignments.

### **Textbooks**

Klir , G.J. and B. Yuan, *Fuzzy Sets and Fuzzy Logic*. Prentice-Hall, 1995.  
 Ross, T.J. *Fuzzy Logic With Engineering Applications*. J. Wiley, 2010.  
 Dujmović, J.J., *Soft Computing Evaluation Logic*. In press. J. Wiley 2017.  
 V. Belton and T.J. Stewart, *Multiple Criteria Decision Analysis: an Integrated Approach*. Kluwer Academic Publishers (2002).

### **Recommended Literature**

Zimmermann, H-J., *Fuzzy Set Theory and its Applications*. Kluwer Academic Publishers (1996).

C. Carlsson and R. Fullér, *Fuzzy Reasoning in Decision Making and Optimization*. Physica-Verlag (2002)  
J. Fodor and M. Roubens, *Fuzzy Preference Modeling and Multicriteria Decision Support*. Kluwer Academic Publishers (1994).  
C. Gini et al., *Means*. Italian original, *Le Medie*, Milano 1958.  
R.L. Keeney and H. Raiffa, *Decisions with Multiple Objectives: Preferences and Value Tradeoffs*. John Wiley (1976).  
P.S. Bullen, *Handbook of means and their inequalities*, Kluwer, 2003.

### **Journals**

IEEE Transactions on Fuzzy Systems, IEEE Transactions on Syst., Man, Cybern., International Journal of Approximate Reasoning, Applied Soft Computing, Fuzzy Sets and Systems, International Journal of Uncertainty, Fuzziness, and Knowledge-Based Systems.

### **Conferences**

FUZZ-IEEE, IPMU, EUSFLAT, AGOP (see Proceedings of these conferences)

**Prepared by:** Jozo Dujmović

**Last Revision Date:** Feb. 14, 2017