

# Soft Computing and Decision Support Systems (CSc 876 )

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**Course Level:** Graduate/Senior undergraduate

**Number of Credits:** 3 (three hours of lecture per week)

**Prerequisite:** Formal prerequisite is CSc 810 or consent of instructor for students who completed CSc 510. Essential prerequisite is a clear interest in individual creative work in the area of computational intelligence, based on standard preparation in mathematical modeling and software development. Undergraduate seniors who satisfy prerequisites are welcome, but CSc 876 is not designed as a traditional homework-exam CS undergraduate elective.

## Topics of interest

Survey of soft computing and related areas of computational intelligence. Decision engineering methods, tools, and applications. The concepts of granulation and graduation. Fuzzy sets, fuzzy logic, and fuzzy systems. Approximate reasoning. Possibility theory. Fuzzy decision making. Fuzzy controllers. Concept of rough sets. Computing with words, perceptual computing, and granular computing. Neural networks and their use. Graded evaluation logic. Study of logic aggregation operators and information fusion models. LSP method for evaluation and optimization of complex systems. Applications of soft computing. Development of software systems for decision support.

## General goals:

- To promote critical thinking as a prerequisite and motivation for creative work.
- To be exposed to recent soft computing research results, decision methods, tools, and applications, presented by their developer (the knowledge that is created is different from the knowledge that is borrowed).
- To learn how to develop new techniques and software tools based on observation, experiments, and modeling of human mental activities.
- To learn how to find, read, and analyze research papers, and how to present research and development results in professionally correct and efficient scientific way.

## Specific goals:

Presentation of selected areas of soft computing in an advanced research-oriented way. In particular, the course will include in-depth presentation of the following topics:

- Observable properties of human reasoning and their modeling.
- Development, validation, and use of graded logic models.
- Graded logic as a soft computing generalization of classic Boolean logic.
- Decision engineering techniques based on the LSP method and corresponding software tools: evaluation and selection of complex objects and alternatives.
- Critical thinking that stimulates developments of soft computing methods and tools.
- Critical reading of modern literature in the area of computational intelligence.
- Cooperative experimental work in modeling human reasoning.
- Development of realistic and justifiable decision criteria.
- Development and use of decision support software.
- Soft computing applications in real estate, medicine, ecology, space management, geography, computer science, and personal decision making.

**Projects and grading:**

CSc 876 has no exams. During the semester students will work on projects related to material presented in the class. Projects will stimulate creativity, independence, critical thinking, and have a moderate research component. Results will be reported in the form of technical reports or research papers. Individual projects will be graded and the final grade will be derived from the grades in individual projects.

**New book:**

This course has a unique opportunity that it is offered simultaneously with the publication of instructor's new book:

Dujmović, J., *Soft Computing Evaluation Logic*. In press. J. Wiley 2018.

The course is expected to benefit from this coincidence.

**Important textbooks:**

Klir, G.J. and B. Yuan, *Fuzzy Sets and Fuzzy Logic*. Prentice-Hall, 2002 India edition

Ross, T.J. *Fuzzy Logic With Engineering Applications*. J. Wiley, 2010.

Pedrycz, W., *Granular Computing*. CRC Press, 2013.

Mendel, J.M and D. Wu, *Perceptual Computing*. J. Wiley, 2010.

**Recommended Literature:**

Kacprzyk, J. and W. Pedrycz, *Springer Handbook of Computational Intelligence*. Springer 2015.

S.N. Shahbazova (Ed.), *Fuzzy Logic and its Applications*. Selected Papers by Lotfi A. Zadeh. Little enterprise, 2016.

B. Kosko, *Fuzzy Thinking*. Hyperion, 1993.

J.M. Mendel, *Uncertain Rule-Based Fuzzy Logic Systems*. Prentice Hall, 2001.

V. Belton and T.J. Stewart, *Multiple Criteria Decision Analysis: an Integrated Approach*. Kluwer Academic Publishers (2002).

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).

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.

Beliakov, G., H. Bustince Sola, and T. Calvo Sanchez. A practical guide to averaging functions. *Studies in Fuzziness and Soft Computing* 329. New York: Springer; 2016.

**Journals that publish research in soft computing:**

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, International Journal of Intelligent Systems, Information Sciences.

**Conferences on soft computing:**

FUZZ-IEEE, IPMU, IEEE WCCI, WCSC, EUSFLAT, AGOP, MDAI (Proceedings of these conferences contain the latest research results in this area).