

MATH/CSCI 8520/9110 Fall 2015

ADV TOPICS OPTIMIZATION / ADV TOPICS APPLIED MATH

Instructor: Zhenyuan Wang

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Office hours: M & W 3:00-4:00 PM or by appointment.

Credits: 3 (hours).

Textbook: Nonlinear Integrals and Their Applications in Data Mining, by Zhenyuan Wang, Rong Yang, and Kwong-Sak Leung, World Scientific (2010).

Course description: The course is focused on using a new mathematical aggregation tool, the nonlinear integral, in nonlinear optimizations and on its applications in information fusion and data mining, which are daily topics of data science in the age of big data. Some soft computing technique (genetic algorithm and/or pseudo gradient search) is adopted to search numerical optimal solutions approximately. The course will use the state of the art research from mathematics and AI area in teaching. The instructor will give lectures in most class meetings to provide some basic knowledge on the following topics; the remaining several weeks will be used for students' presentations (on relevant research papers in literature and students' own projects). Class participation will also be graded.

Topics: The course involves the following topics.

1. Modeling on linear and nonlinear optimization problems.
2. Information fusion.
3. Nonadditive set functions (signed efficiency measures) and their applications.
4. Nonlinear integrals as a new aggregation tool used in information fusion.
5. Data mining as the inverse problem of information fusion.
6. Genetic algorithms used in optimization.
7. Pseudo gradient search.
8. Nonlinear multiregressions.
9. Nonlinear classification.

Project: All students are required to complete a project on the theory of nonadditive set functions and relevant nonlinear integrals or the applications of nonlinear optimization.

Research paper: The students are encouraged (are required for students who register for Math 9110) to complete a research paper, which can be submitted to some conference or journal, on nonadditive set functions, nonlinear integrals, nonlinear optimization, or their applications.

Attendance policy: Punctual attendance at all class meetings is a requirement for the course. Students should sign for each class meeting.

Drop policy: The deadline to drop with a grade of "W" is November 6, midnight.

Course grade: The instructor gives students' grade based on the homework (25%), the performance in presentation and discussion (25%), a test (25%) and the quality of project report (25%).

Resource material:

Books

1. *Fuzzy Measure Theory*, Wang and Klir, Plenum Press, 1992.
2. *Non-Additive Measure and Integral*, Denneberg, Kluwer Academic Publishers, 1994.
3. *Null-Additive Set Functions*, Pap, Kluwer Academic Publishers, 1995.
4. *Machine Learning—Neural Networks, Genetic Algorithms, and Fuzzy Systems*, Hojjat, John Wiley, 1995.
5. *Data Mining—Concepts and Techniques (3rd ed.)*, Han, Kamber, and Pei, Morgan Kaufmann Publishers, 2011.
6. *Generalized Measure Theory*, Wang and Klir, Springer, 2008.
7. *Nonlinear Integrals and Their Applications in Data Mining*, Wang, Yang, and Leung, World Scientific, 2010.

Journals

1. *Fuzzy Sets and Systems*.
2. *IEEE Trans. of Fuzzy Systems*.
3. *IEEE Trans. of SMC-B*.
4. *Journal of Mathematical Analysis and Applications*.
5. *Journal of Intelligent and Fuzzy Systems*.

If you have questions with the course material, need to be absent for the class, or have any other circumstance that may affect your performance in the course, please contact me as soon as possible.

Reasonable accommodations are provided for students who are registered with Disability Services and make their requests sufficiently in advance. For more information, contact Disability Services (EAB 117, Phone: 554-2872, TTY: 554-3799) or go to the website: www.unomaha.edu/disability.