Fall 2012

CS 7840: Soft Computing

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Soft Computing - CS 7840
Fall 2012, Wright State University

Objectives and Goals

This course explores soft computation from historical, theoretical, and application viewpoints. Soft computing methods to be considered include evolutionary computation, neural computation, fuzzy set theory, and approximate reasoning. Applications to problems in optimization, control, and classification will be presented.

Recommended Preparation

* Familiarity with multivariate calculus, linear algebra and matrix algebra.
* Familiarity with basic descriptive and inferential statistics.
* Mastery of at least one programming language.
* Mastery of practical data structures and basic complexity analysis.
* MATLAB experience desirable, but not necessary

Meeting Time and Place

Tuesday and Thursday, 6:30 PM – 7:50 PM
193 Joshi Research Center

Instructor

John C. Gallagher
352 Russ Engineering Center
john.gallagher@wright.edu (email preferred to phone)

Office Hours

5:30 – 6:30 and 7:30 – 8:30 PM T/Th or by appointment.

Programming Languages and Tools

The course will be programming language agnostic. You may complete projects and assignments using any programming environment you like, so long as the instructor has a way to compile and run your assignments. MATLAB and/or Octave are, however, particularly good choices. Familiarity with Matlab and/or Octave is, therefore, encouraged.

Textbooks

Neural Network Textbook
Neural Networks and Learning Machines (Third Edition)
Author – Simon Haykin: Publisher – Pearson
http://www.amazon.com/Neural-Networks-Learning-Machines-3rd/dp/0131471392

Evolutionary Computation Textbook
Introduction to Evolutionary Computing
Author – A.E. Eiben and J.E. Smith: Publisher – Springer
http://www.amazon.com/Introduction-Evolutionary-Computing-Natural-Series/dp/3540401849/ref=tmm_hrd_title_0

Fuzzy Logic Textbook
Online Materials to be Provided

Grading

Student grades will be determined by assessment of each of the following:

i. ability to discuss the relative merits of contemporary soft computing methods
ii. ability to implement and debug contemporary soft computing systems
iii. ability to identify and articulate open issues yet to be addressed by contemporary researchers

Each student will be provided with ample opportunity to demonstrate these abilities through written examinations, programming assignments, oral presentations, and a term project. We will use a standard 90/80/70/60 scale for letter grades.

Grades will be computed as follows:

4 Assignments	40%
1 Case Study Review	10%
1 Midterm Exam	20%
1 Final Exam	30%

Assignments

You will be asked to complete four assignments. Each assignment will require implementation and test of specific soft computation methods developed in class.

Case Study Review

At the end of the course, you will be presented with a number of case studies in the use of soft computing techniques in practical and research problems. You will be asked to prepare a review of one of the case studies in which you summarize the main tools used and suggest improvements and/or extensions to the work presented. Your review should be grounded in the concepts and analyses provided in lectures and readings.

Midterm Exam

The midterm exam will be given approximately half way through the semester and will cover all neural network material previously covered in the course. The exam will closed book, however, you will be permitted a single one-sided page of handwritten notes. The notes must be original copies (no photocopies of a common set of notes) and unique to each student in the exam.

Final Exam

The final exam will be similar to the midterm, except that it will cover all material covered in the course and students will be permitted TWO one-sided sheets of handwritten notes.

Academic Integrity

It is the policy of Wright State University to uphold and support standards of personal honesty and integrity for all students. The formal university code of student academic conduct can be viewed at :

http://www.wright.edu/students/judicial/integrity.html

PLEASE BE FAMILIAR WITH THE ACADEMIC CODE OF CONDUCT. If the instructor detects infractions, he will follow the procedures outlined in the formal university policy. These policies are easily available for review. Therefore, ignorance of the law is no defense.

Additional Information

Absences

Class attendance will not be a direct factor in student grades, but will strongly affect the quality of one's class experience. Students are expected to attend every class, as things may make less sense to students that do not attend classes or who arrive late. Students registering after the term begins are responsible for all missed material and should not expect that due dates will be altered.

Office Hours

Office hours *are not private lectures*. It is expected that students attend and participate in lectures and use office hours for *additional discussion* of issues related to class topics. Related topics include clarification of lecture points, remediation advice, or expansion beyond textbook materials. You will get the most out of office hour visits by preparing *specific questions and/or examples ahead of your visit.* Make an attempt to solve problems on your own before coming to office hours even if you don't expect to solve the problem correctly. Being able to examine where things (might have) gone wrong is at least as valuable as examining things that didn't go wrong. The instructor may be able to help diagnose problems in understanding or execution – but only if there are concrete examples of your work to examine.

Class Lecture Materials

Copies of the transparencies used in lecture, supplementary textbooks, and additional course-related information will be available on the course WWW page for student reference. Students are responsible for being aware of the WWW page's contents. Students that do not have active computer accounts or are otherwise unable to access the course WWW page should contact the instructor so appropriate computer access arrangements can be made.

Course Schedule

Date	Topic / Event	Reading	Assignment
08/28	Course Introduction		
08/30	Neural Models, Architectures, and Learning	NNLM 1.1, 1.2, 1.3	
09/04	Single Layer Perceptrons	NNLM 1.1, 1.2, 1.3	
09/06	Single Layer Perceptrons	NNLM 4.1 – 4.6	
09/11	Multilayer Perceptrons	NNLM 4.1 – 4.6	
09/13	Multilayer Perceptrons	NNLM 4.11 – 4.13	
09/18	Multilayer Perceptrons	NNLM 4.14 – 4.16, 4.20	
09/20	Principle Component Analysis (PCA)	Handouts	Assignment #1 Friday 09/21
09/25	PCA / Self Organizing Maps	NNLM 8.1, 8.2, 8.5, 8.6, 8.7	
09/27	Self Organizing Maps	NNLM 9.1, 9.2, 9.3, 9.4	
10/02	Neurodynamics and Hopfield Networks	NNLM 13.1 – 13.7, 13,8, 13.10	
10/04	Neurodynamics and Hopfield Networks	NNLM 13.1 – 13.7, 13,8, 13.10	
10/09	Evolutionary Computation: Applications and Strengths	IEC 1 and 2	
10/11	Genetic Algorithms	IEC 3	Assignment #2 Friday 10/12
10/16	**MIDTERM EXAM**		**MIDTERM 10/16**
10/18	Genetic Algorithms	IEC 3	
10/23	Evolutionary Strategies / Evolutionary Programming	IEC 4 and 5	
10/25	Evolutionary Strategies / Evolutionary Programming	IEC 4 and 5	
10/30	Theory: Hill Climbing vs. Hyperplane Sampling and Related Topics	IEC 11 and handouts	
11/01	Theory: Hill Climbing vs. Hyperplane Sampling and Related Topics	IEC 11 and handouts	Assignment #3 Friday 11/02
11/06	Parameter Tuning and Parameter Adaptation in EAs	IEC 8	
11/08	Fuzzy Logic: Applications and Strengths	Handouts	
11/13	Fuzzy Logic: Sets, Relations, and Composition	Handouts	
11/15	Fuzzy Logic: Interference and Defuzzification	Handouts	
11/20	Fuzzy Logic: Union, Intersection, and Cartisian Product	Handouts	Assignment #4 Friday 11/20
11/22	Thanksgiving Day – No Class		
11/27	Case Study: Game Playing – Blondie24	Handouts	
11/29	Case Study: Flapping Wing Air Vehicle	Handouts	
12/04	Case Study: Pattern Recognition	Handouts	
12/06	Review and Course Debriefing		
12/13	**FINAL EXAM (5:45 – 7:45)**		**FINAL 12/13**

NNLM X.Y = Neural Networks and Learning Machines Chapter X section Y
IEC X = Introduction to Evolutionary Computation chapter X
Handouts = Instructor Provided Materials