Summer 2013

CS 7840: Soft Computing

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Soft Computing - CS 7840
Summer 2013, 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, 4:40 PM – 6:20 PM
154 Russ Engineering Center

Instructor

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

Office Hours

6:30 to 7:30 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:

3 Assignments	45%
1 Mini Project	25%
3 Topic Quizes	30%

Assignments

You will be asked to complete three assignments. Each assignment will require implementation and test of specific soft computation methods developed in class. These assignments are intended to allow you to demonstrate your ability to implement and test basic soft computing systems.

Mini Project

At the end of the course, you will be asked to complete a mini-project where you will be encouraged to bring any soft computation methods you know to solve a simple practical problem. This project is intended to allow you to demonstrate your ability to make good choices and convincingly demonstrate success.

Topic Quizes

There will be three topic area quizzes for each of the three major topic areas in the class (neural networks, evolutionary computation, and fuzzy logic). These quizzes are intended to test you knowledge of those specific areas.

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 available for review at the given web link.

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. 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 slides used in lectures, supplementary textbooks, and additional course-related information will be available via web links that will be supplied in email messages to registered students.

Course Schedule

Week	Date	Topic / Event	Reading	Assignment
1	05/07	Course Introduction		
1	05/09	Neural Models, Architectures, and Learning	NNLM 1.1, 1.2, 1.3	
2	05/14	Single Layer Perceptrons	NNLM 4.1 - 4.6	
2	05/16	Multilayer Perceptrons	NNLM 4.11 - 4.13	
3	05/21	Multilayer Perceptrons	NNLM 4.14 - 4.16, 4.20	
3	05/23	PCA / Self Organizing Maps	Handouts, NNLM 8.1, 8.2, 8.5, 8.6, 8.7	
4	05/28	Self Organizing Maps	NNLM 9.1, 9.2, 9.3, 9.4	Assignment #1 - Perceptrons
4	05/30	Neurodynamics and Hopfield Networks	NNLM 13.1 - 13.7, 13,8, 13.10	
5	06/04	Expansion Day / Special Topics	TBD	
5	06/06	Neural Network Case Study	Handouts	
6	**06/11**	**Neural Network Quiz**		
6	06/13	Evolutionary Computation: Applications and Strengths	IEC 1 and 2	
7	06/18	Genetic Algorithms	IEC 3	Assignment #2 - Self Organizing Maps
7	06/20	Evolutionary Strategies / Evolutionary Programming	IEC 4 and 5	
8	06/25	Theory: Hill Climbing vs. Hyperplane Sampling and Related Topics	IEC 11 and handouts	
8	06/27	Parameter Tuning and Parameter Adaptation in EAs	IEC 8	
9	07/02	Evolutionary Algorithm Case Study	Handouts	
9	07/04	Holiday - University Closed		
10	**07/09**	**Evolutionary Algorithms Quiz**		
10	07/11	Fuzzy Logic/Sets: Applications and Strengths		Assignment #3 - GA vs. EA
11	07/16	TBD		
11	07/18	TBD		
12	07/23	TBD		
12	07/25	**Fuzzy Logic Quiz**		Assignment #4 - Mini Project

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