CE 359 APPLIED ARTIFICIAL NEURAL NETWORKS Spring 2015

Instructor: Donna Rizzo, 213 Votey, 656-1495, drizzo@uvm.edu

Class Times: Tu/Th 1:00-2:15 in Perkins 101

Office Hours: M, Tu & W 5:00-6:30 **Text:** See handouts and list of references.

COURSE DESCRIPTION: This course introduces you to the field of artificial neural networks (or ANNs). I expect you to have fun in this course and be creative. You are expected to experiment with the ANN algorithms, by studying, playing with and implementing a few (minimum of six) ANN paradigms. A broad range of example applications and equations that govern each network's computation will be covered. Students are expected to code each algorithm in MATLAB. Grading is based on 8 programming assignments, a critical review with class discussion of a journal article, and a final project presentation describing an individual research project of your choosing.

The assignments (and grading distribution) for the course comprise four parts:

1) Homework (7 ~weekly assignments)	75%
2) Short Exam	10%
3) Analytical Ability (including project innovations & class participation)	10%
4) Final Presentation (describing your analysis and results)	5%

(Week) - Date	Topics	Homework
(1) - 1/13/15	Introduction/Perceptrons Multi-layer Networks	Read pages 165-184 (L. Nunes de Castro)
(2) - 1/20/15	Backpropagation Momentum	Hmwk # 0.5: Backpropagation algorithm
(3) - 1/27/15	Recurrent Networks Project Updates	Hmwk # 1: Backprop w/ Momentum *or* Recurrent Backprop
(4) - 2/03/15	No class Hopfield Networks	Hmwk # 2: Hopfield algorithm
(5) - 2/10/15	Bidirectional Associative Memory Project Updates	
(6) - 2/17/15	Counterpropagation Network Normalization	Hmwk # 3: Counterpropagation algorithm
(7) - 2/24/15	Self Organizing Maps (SOM) Project Updates	Hmwk # 4: SOM algorithm
(8) - 3/03/15	No class No class	SPRING BREAK SPRING BREAK
(9) - 3/10/15	Padaline Project Updates	Short Exam (on class notes and algorithms to date)
(10) - 3/17/15	GRNNs Project Updates	Hmwk # 5: Padaline algorithm
(11) - 3/24/15	Evolutionary Networks	Hmwk # 6: GRNN algorithm
(12) - 3/31/15	PCNs	
(13) - 4/07/15	Journal Articles	Hmwk # 7: Article discussion & critical review
(14) - 4/14/15	Recurrent Networks	
(15) - 4/21/15	Spiking ANNs (with Guest Presentation) OR Deep Belief Network	Hmwk # 8: Individual project (code)
(16) - 4/28/15	Project Presentations Project Presentations	Wrap up & Review Last Day of Class (Final Exam Period)

READING ASSIGNMENTS:

Hmwk 1 and 2 (Introduction and Backpropagation):

- Chapters 1, 2 and 3 of Negnevitsky, M. (2005), Artificial Intelligence – A guide to Intelligent Systems, Addison Wesley.
- Chapter 3 on Minsky M. and Papert (1969) Perceptrons, An introduction to computational geometry, MIT press, available on course reserve at the Bailey-Howe Library.

Hmwk 2 and 3 (Recurrent Artificial Neural Networks and Hopfield Networks):

- Read the following two journal articles:
    1. John Hopfield, "Neural networks and physical systems with emergent collective computational abilities", *Proceedings of the National Academy of Sciences of the USA*, **79** 1982, pp. 2554–2558.
    2. John Hopfield, "Neurons with graded response have collective computational properties like those of two-state neurons," *Proceedings of the National Academy of Sciences of the USA*, **81** 1985, pp. 3088–3092.

  For your convenience, both appear in Anderson and Rosenfeld, *Neurocomputing*, vol. 1, MIT Press, 1988, which is on reserve.

Hmwk 4 and 5 (Counterpropagation and Self Organizing Maps (SOMs)):

- Chapter 6 of Caudill, M. (1992), Understanding Neural Networks, The MIT Press. (ISBN-10: 0262530996)
- Haykin, S., Neural Networks: A Comprehensive Foundation, Prentice-Hall, Englewood Cliffs, NJ (1999)
- DARPA Neural Network Study (October, 1987-February, 1989). MIT Lincoln Lab.

Hmwk 6 and 7: (Project Update and GRNN algorithm)

- Industrial Applications of Neural Networks (research reports Esprit, I.F.Croall, J.P.Mason)

Hmwk 8 and 9 (Paladine ANN and Journal Article Discussions):

The reading and discussion of a selected journal article is used to further the understanding of the current topics, as well as to help us all deal with the difficulties of communicating science well. In groups (of two) you will help lead the class discussion and the author's approach to collecting and presenting data and opinions.

Academic Honesty: Students are expected to be familiar with and abide by the UVM academic honesty policy as described in the CAT'S TAIL.

Graduate Certificate in Complex Systems:
This course is applicable toward a 5-course graduate certificate in complex systems at UVM. If you are potentially interested in the Certificate you should **apply now**, since at most 2 courses taken (at UVM or elsewhere) *during or prior to the semester in which you are accepted into the Certificate* are allowed towards the Certificate. Application is free for current UVM Graduate Students via the form: http://www.uvm.edu/~gradcoll/pdf/CertificateApplicationCurrentStudents.pdf For more information go to www.uvm.edu/complexsystems and select "Certificate of Graduate Study".