NEURAL NETWORKS I

Neural networks is a computational and engineering methodology based on emulation of nature’s implementation of the biological brain (in particular, the brain’s massively parallel and learning aspects). As such it holds promise for significant impact on how important classes of scientific and engineering problems are solved. The objective of the this course is to have the students obtain a working knowledge of this forefront technology which is in the midst of a (second) renaissance.

This course covers basic ideas of the neural network (NN) methodology, a computing paradigm whose design is based on models taken from neurobiology and on the notion of "learning." A variety of NN architectures and associated computational algorithms for accomplishing learning are studied. Experiments with various NN architectures are performed via a (commercial) simulation package. Students also use the simulator to complete a classification project.

Prerequisites: senior standing in ECE or CS, graduate standing, or permission of instructor.

Texts:

Note: The $160 “lab fee” charged for this course entitles the student to a one-year license to use the NeuralWorks Professional II/Plus software package (list price $1995), via a site license agreement with NeuralWare, Inc. ($80 for this portion), and the four-volume User’s Guide is provided on the software CD ROM (the second $80 portion of the fee) [the latter includes text #2 above].

Schedule for Winter 2012:
Topics to be covered include: intro/overview; single-layer feed-forward networks (Perceptrons, Adaline); multi-layer feed-forward networks (including well-known Backpropagation algorithm); feedback networks/ associative memories (Hopfield, BAM, BSB); unsupervised learning/self-organizing networks (Competitive, Counterprop, LVQ, SOFM, ART); and reinforcement learning. General ideas applicable to all will be discussed throughout the term, e.g., notions of performance criteria, network capacity, ability to generalize well, etc.

In addition to the reading assignments, there will be assignments on the simulator to experiment with the different types of neural network architectures being studied, with a major project given during the last three to four weeks of the term based on a problem and data that will be provided.

The Haykin book, first published in 1999, is intended to be a comprehensive book on the field. Covering all the material in this book would likely take (at least) a full-year course. Lectures are not directly derived from the text so either the 2nd or 3rd edition will be useful. For examinations you will be held responsible mostly on material presented in class. Selected text material is assigned to supplement lecture coverage. The Haykin book will serve as an excellent reference resource for you as you pursue further study and/or application of this material in your future professional activities.

Assignments: All assignments will be given in class and will be available on the course web page as they are given.

Exams: In-class midterm exam (Wednesday, February 8) and in-class final exam (Monday, March 19, 1730 -1920).

Grading:
- In-class exams: 20% for midterm, 30% for final
- Homework: 20%
- Project: 30%
  * Graduate students will be assigned additional homework and be evaluated according to a “higher standard.”
  * Late assignments will be docked 10% per day late unless prior arrangements are made before the due date.

Note: Neural Networks II will not be offered in Spring 2012.