PORTLAND STATE UNIVERSITY
EE 455/555, & SySc 575 Winter, 2009
G.G. Lendaris, 725-4988, lendaris@sysc.pdx.edu M W, 6:40-8:30 pm, URBN 303

Neural Networks I

[Course Web page: http://www.pdx.edu/sysc/courses_winter2009.html; then click on *AI:Neural Networks I*]

Neural networks is a computational and engineering methodology based on emulating how nature has implemented 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 two-term sequence is to have the students obtain a working knowledge of this forefront technology.

Neural Networks I (Winter term): 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 of the available architectures are performed via a (commercial) simulation package. Students do a project on the simulator. Prerequisites: senior standing in EE or CS, or graduate standing.

Texts:

1. *Neural Networks and Learning Machines,* 3rd Ed., Simon Haykin, Prentice Hall, 2009.
2. *Neural Computing* (tutorial volume of manual for the NeuralWorks simulation package), NeuralWare, Inc., 1993. [Available on CD ROM of NeuralWorks Simulation software.]

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 licence 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, 2009.

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* (developed more in NN-II class). 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 do experimentation with the types of neural network architectures being studied, with a major project given during the last 3-4 weeks of the term, based on a problem and data that I will provide.

While this is the 21st year I am offering this course, neural networks continue to be a rapidly developing field. In the early years, I used a different text book virtually every other year. Since 2000, however, I have continued to use the Haykin book, which was published in 1999. The Haykin book 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. My lectures are not directly from the text. As far as examinations are concerned, you will be held responsible mostly on the 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: There will be one in-class midterm exam, and an in-class final exam.

[**Neural Networks II (Winter term):** Focus is on *applications* of the neural network methodology appearing in the literature. Sufficient theoretical material in selected area(s) is covered, and then neural network applications to those areas are explored. An additional topic to be covered is Fuzzy Set Theory. Applications will include control systems, pattern recognition and other timely topics. Students do an application project of their choice (using the NN simulator). Prerequisite: Neural Networks I.