CS 791S Artificial Neural Networks
Fall 1999

Prerequisites

This course requires that the students have previously taken courses on programming (CS201, CS202), data structures (CS308), calculus (MATH 181, MATH 182), and linear algebra (MATH 330). Courses on image processing, computer vision, machine learning, artificial intelligence, and genetic algorithms are recommended, but not required.

Credit hours: 3.0

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Office Hours: TR: 2:30 - 4:00 pm or by appointment.

Required Text:

Neural Network Design, by M. Hagan, H. Demuth and M. Beale, PWS Publishing Company, 1996.

Other Texts (not required):

Neural Networks: A Comprehensive Foundation (2nd edition), by S. Haykin, Prentice Hall, 1999.
Elements of Artificial Neural Networks by K. Mehrotra, C. Mohan, and S. Ranka, MIT Press, 1997
Pattern Recognition Using Neural Networks by C. Looney, Oxford University Press, 1997
Neural Networks for Pattern Recognition by C. Bishop, Oxford University Press, 1995

Objectives

Neural networks provide a model of computation drastically different from traditional computers. Typically, neural networks are not explicitly programmed to perform a given task; rather, they learn to do the task from examples of desired input/output behavior. The networks automatically generalize their processing knowledge into previously unseen situations, and they perform well even when the input is noisy, incomplete or inaccurate. These properties are well-suited for modeling tasks in ill-structured domains such as face recognition, speech recognition and motor control.

This course will cover basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision. Three forms of learning will be introduced (i.e., *supervised, unsupervised and reinforcement learning*) and applications of these will be discussed. The students will have a chance to try out several of these models on practical problems.

This is an **advanced level course** suited for graduate students in Computer Science and Engineering. It is primarily intended for **highly motivated** graduate students who are interested in doing research in the areas of Neural Networks and Computer Vision. There are many open problems in this areas suitable for investigation by Master's students leading to a professional paper or master thesis. The course contains three main parts:

• Lectures (instructor)
• Paper presentations/discussion (students)
• Semester project (students)

Course Outline (tentative)

• Introduction (Chapter 1)
• Neuron Model and Network Architectures (Chapter 2)
• An Illustrative Example (Chapter 3)
• Perceptron Learning Rule (Chapter 4)
• Background on Linear Algebra (Chapters 5 & 6)
• Supervised Hebbian Learning (Chapter 7)
• Background on performance surfaces and optimization (Chapters 8 & 9)
• Widrow-Hoff Learning (Chapter 10)
• Backpropagation (Chapters 11 & 12)
• Associative Learning (Chapter 13)
• Competitive Networks (Chapter 14)

Course Policies

We will spend the first half of the semester with lectures covering the fundamentals of Neural Networks. During the second half of the semester, we will emphasize applications of Neural Networks. For this, each student is expected to choose a problem of his/her interest, study several papers related to this problem, and give 2-3 presentations to the rest of the class. The presentation of the material should be **professional** as if it was presented in a formal conference. The student who is responsible for presenting a paper(s) on a specific day is expected to be well prepared and have a good understanding of the ideas discussed in the paper. Every other student is expected to have read the paper at least once so he/she can participate in the class discussion.

Each student is expected to complete a research project. Projects will be done on an individual basis and no group projects will be allowed. Ideally, the project will target a problem relevant to the graduate student's own research interests (assuming they are related to Computer Vision). There will be a number of project reports during the semester as well as a demo at the end of the semester.

Grading

Your grade will determined based on a midterm exam, paper presentations, participation in class discussion, and project reports and demo. Note that good programming skills and a lot of motivation are essential in order for someone to complete the project successfully. Programming can be done using either C or C++. A number of neural networks software packages will be available to assist you in the implementation phase of your project (please, visit the course's homepage at **http://www.cs.unr.edu/~bebis/CS791S** for more information).

Grading Scheme

Midterm: 15%
Presentations: 15%
Participation in class discussion: 10%

Project: 60%

- Interim report: 10%
- Final report: 20%,
- Implementation, Experiments, Demo: 30%

Important dates

10/28/99 - Midterm exam
10/15/99 - last day for dropping classes
11/11/99 - no classes (Veterans Day)
11/25/99 - no classes (Thanksgiving Day)
12/7/99 - last day of classes