Psychology 410/510
Network Modeling
Spring 1994: TTH 14:00-15:20 (154 Straub)

Instructor: Margaret Sereno
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office hours (211 Straub): TTH 3:30-4:30 (or by appointment)

Readings: Text: <u>Neural Network Architectures</u> by J. Dayhoff (1990).
and 1 packet of articles available at Campus Copy.

Topics & Readings:

3/29 Organizational Meeting and Introduction--*Dayhoff Ch 1*
3/31 Historical Background--*Dayhoff Ch 2*

4/5 Neuroscience Background--*Dayhoff Ch 7&8; Kandel et al. Ch 65*
4/7 Basic Elements of Neural Networks--*Wasserman Appendix B*

4/12 Associative Nets--*Anderson (pp. 799-808)*
4/14 Hebbian and Self Organizing Networks--*Linsker*

4/19 Hebbian and Self Organizing Networks--*Linsker*
4/21 Hebbian and Self Organizing Networks--*Dayhoff Ch 9*

4/26 Back Propagation--*Dayhoff Ch 4*
4/28 Back Propagation--*Dayhoff Ch 5*

5/3 **MIDTERM EXAM**
5/5 Guest Lecture

5/10 Recurrent Nets: Hopfield Nets and Boltzman Machines--*Dayhoff Ch 3*
5/12 Recurrent Nets: Hopfield Nets and Boltzman Machines--continued

5/17 Recurrent Nets: Brain-State-in-a-Box--*Anderson (pp. 808-815)*
5/19 Adaptive Resonance Theory--*Wasserman Ch 8*

5/24 Vision: Motion Networks--*Sereno & Sereno*
5/26 Vision: Pattern Recognition--*Wasserman Ch 10; Le Cun et al.*

5/31 Memory: Short Term Memory--*Zipser et al.*
6/2 Language: Sentence Processing--*Elman*; Lesioning Networks--*Hinton et al.*
Final Projects Due

6/6 **FINAL EXAM**--Monday at 1:00 p.m.

Course Description:

The use of computer simulations in cognitive science (and the empirical sciences in general) has mushroomed in the past few years. Model building has many important functions: 1) it forces a precise specification of verbal theories; 2) it allows for the exploration of new ideas and complex phenomena; and, 3) it often predicts counterintuitive findings or uncovers hidden relationships.

This course explores brain-style computer models of cognition. These models, known as "neural networks" or "connectionist models", are useful in explaining the brain's ability to process, store, and retrieve information. The first part of the course considers the historical development of the field, reviews some basic mathematical techniques, and outlines and compares basic elements of real and artificial neural networks. Next, several classes of networks are discussed (Associative Nets; Backpropagation Nets; Hebbian and Self-Organizing Nets; Hopfield Nets, Boltzman Machines, other Recurrent Nets). The final part of the course examines specific applications of neural networks to problems in memory, perception, and language.

Course Work:

Course work includes computer exercises, two exams, homework assignments (ungraded), and a modeling project (required for graduate students; optional for undergraduate students). A background in computer programming is not required for this course. Some familiarity with Linear Algebra is recommended.

Computer exercises: A few of the models discussed in class are explored in more detail through the use of a network simulator (MacBrain) on a Macintosh computer (available in the psychology department). The purpose of these exercises is to provide hands-on experience with various models.

Exams: The exams consist of a mix of essay questions and short quantitative problems. There will be a midterm and a final (which is not cumulative).

Homework assignments: These include questions and problems designed to aid in the understanding of basic concepts covered in class.

Project: The modeling project involves proposing and implementing a model of some aspect of cognitive behavior. The simulator can be used or an original program written. A summary of the project should be turned in. This summary includes a description of the phenomenon modeled, the model used (architecture, learning algorithms, procedures, etc.), and the results obtained (including examples or a summary of simulation results).

Grading:

	410 students	510 students
Exercises:	40%	25%
Exam #1:	30%	25%
Exam #2:	30%	25%
Project:	*	25%

(* up to 10 points extra credit)