

Syllabus for

CONNECTIONISM

J. Hernandez Cruz & Neil Stillings

School of Cognitive Science

100 Adele Simmons Hall

Amherst, MA 01020

Although the scientific study of the mind as a distinct discipline has been around for only a short time, there are already rumblings of a fundamental change in view about what the mind is like. At the center of this controversy is a cluster of approaches that are together variously called connectionism, neural network modeling, parallel distributed processing (PDP), or dynamic systems theory. This course is an intensive introduction to the connectionist's proposals for thinking about the mind and understanding its achievements. At the same time, it is an introduction to one way of conducting an interdisciplinary science where the boundaries between psychology, philosophy, neuroscience, computer science and mathematics are not set.

We will alternately investigate and take seriously the psychological elements, the technical/mathematical elements, and the philosophical elements of connectionism. We will sometimes take on the role of the scientist looking for a detailed and satisfying theoretical account of how perception, memory, learning, reasoning or motor control works. At other times we will take on the role of the philosopher wondering after the nature of the mind, the limits of psychology and the relationship between scientific models of minds and real minds.

Required Texts:

1. Bechtel, William & Abrahamsen, Adele (1991) *Connectionism and the Mind*. Cambridge, MA: Blackwell.
2. Caudill, Maureen & Butler, Charles (1992) *Understanding Neural Networks, Vol. 1: Basic Networks*. Cambridge, MA: MIT Press. (Includes software)*
3. Collected Readings by various authors. Available at the Hampshire College bookstore.

*If you own a Mac or intend to use Hampshire's computer labs, purchase the Mac version. If you own an IBM, purchase the IBM version.

To RECEIVE AN EVALUATION, you must:

1. *Participate* - Thoughtful participation in class discussion will be one indicator that you are doing the reading.
2. *Write all semi-weekly papers* -- 1-2 pages on assigned topics. Typewritten, double spaced in a 12 point font. No title page. Papers must reflect original thoughts and ideas about the assigned themes. Any direct

quotations or paraphrased material from outside sources must be credited and footnoted in your favorite style.

3. *Complete in-book problem sets* - The Caudill & Butler book includes exercises within and at the end of each chapter. Students will be required to turn in a clear photocopy of their completed work according to deadlines in the schedule.

4. *Complete a final project* - Students may choose one of three types of final class project. Final projects may be extensions of a semi-weekly paper or may advance completely new ideas. Well crafted and revised final class projects may qualify as project-based Division I examinations.

Psychological literature review paper: A 12-15 page paper reviewing the psychological literature on some mental capacity along with actual or possible connectionist approaches to that capacity. See the [Psychology bibliography](#) available from the instructors.

Philosophical Review paper: A 12-15 page paper analyzing some element of the connectionist approach to cognitive science as it interacts with the philosophy of mind. See the [Philosophy bibliography](#) available from the instructors.

A Connectionist Model: Using the Caudill & Butler software or other available software, a well thought-out exploration of a connectionist model with a brief (5-7 page) write-up.

Schedule of Topics & Readings

I. THE SCIENTIFIC STUDY OF THE MIND

September

04 Discussion: Introduction

09 Discussion: Representations

Readings: Selection from Thagard's *Mind: Representation and Computation*, in reader

11 Discussion: More on representations

Readings: Selection from Crane's *Mechanical View of the Mind: The Puzzle of Representation*, in reader

Assignment: Paper #1

16 Discussion: Computations

Readings: Selection from Crane's *Mechanical View of the Mind: Computers and Thought*, in reader

18 Discussion: More on computations

Readings: No new readings (re-read Thagard & Crane selections)

II. THE CONNECTIONIST VIEW OF THE MIND

- 23 Discussion: Introduction to Connectionism
Readings: Bechtel & Abrahamsen, Chapter 1 (pp. 1-20)
- 25 Discussion: More on Connectionism
Readings: McClelland, Rumelhart & Hinton
The Appeal of Parallel Distributed Processing, in reader

Assignment: Paper #2
- 30 Discussion: Hands-on connectionism - The perceptron
Readings: Caudill & Butler, Chapters 1 & 3 (pp. 1-14, 27-36)

Assignment: Exercises from Caudill & Butler

October

- 02 Discussion: Hands-on connectionism - The adaline
Readings: Caudill & Butler, Chapter 4 (pp. 37-58).
- 07 Discussion: More on the adaline
Readings: No new readings
- 09 Discussion: Is the adaline learning?
Readings: No new readings

Assignment: Caudill & Butler Chapter 4 exercises
- 16 Discussion: Types of Connectionist architectures
Readings: Bechtel & Abrahamsen, Chapter 2 (pp. 21-65)
- 21 Discussion: Representation in Connectionism
Readings: Hinton, McClelland, and Rumelhart
Distributed Representations, in reader
- 23 Discussion: Our Understanding of Connectionism so far
Readings: No new readings (re-read Bechtel & Abrahamsen, Ch. 2)

Assignment: Paper #3

III. UNDERSTANDING CONNECTIONIST MODELS

- 28 Discussion: Increasingly sophisticated learning - Hebbian
Readings: Caudill & Butler, Chapter 5 (pp. 59-82)
- 30 Discussion: Increasingly sophisticated learning - Hebbian
Readings: Bechtel & Abrahamsen, Chapter 3 (pp. 66-85)

Assignment: Caudill & Butler, Chapter 5 exercises.

November

04 Discussion: Increasingly sophisticated learning - Competitive
Readings: Caudill & Butler, Chapter 6 (pp. 83-108)

06 Discussion: Increasingly sophisticated learning - Competitive
Readings: Bechtel & Abrahamsen, Chapter 3 (pp. 99-105)

Assignment: Caudill & Butler, Chapter 6 exercises.

IV. EXPLORING CONNECTIONIST COGNITIVE SCIENCE

11 Discussion: Controversies over a model of past-tense acquisition
Readings: Bechtel & Abrahamsen, Chapter 6 & 7

13 Discussion: Modeling categorical vs. coordinate spatial relations
Readings: Kosslyn et al, Categorical versus coordinate spatial relations:
computational analyses and computer simulations, in reader

20 Discussion: Critique of Kosslyn et al and reply
Readings: Cook et al, The Cerebral Hemispheres and Neural Network Simulations:
Design Considerations
Kosslyn et al, Spatial Relations Encoding in Computers and People:
Making the Connection

Assignment: Paper #4

25 Discussion: Backpropagation
Readings: Caudill & Butler, Chapter 10 (pp. 171-196)

27 Discussion: More on Backpropagation
Readings: No new readings

Assignment: Caudill & Butler, Chapter 10 exercises.

V. PHILOSOPHICAL AND THEORETICAL ISSUES

December

02 Discussion: Cognitive science and folk psychology
Readings: Ramsey, Stich & Garon Connectionism, Eliminativism and the
Future of Folk Psychology, in reader

04 Discussion: Beliefs in Connectionism
Readings: Smolensky, On the Projectible Predicates of Connectionist Psychology:
A Case for Belief, in reader

09 Discussion: Does eliminativism follow from the falsity of folk psychology?
Readings: Stich & Warfield, Do Connectionist Minds Have Beliefs?, in reader.