

Psychology 429
Introduction to Connectionism in Cognitive Psychology
University of Chicago
Fall 1991
Lawrence W. Barsalou

Office

313 Beecher
702-4193
Hours: Tuesday and Thursday 2:30 - 4:00

Texts, Readings, and Lecture Notes

Texts

RM = Rumelhart, D.E., McClelland, J.L., and the PDP Research Group (1986). *Parallel distributed processing. Explorations in the microstructure of cognition, Vol. 1. Foundations*. Cambridge, MA: MIT Press.

MR = McClelland, J.L., Rumelhart, D.E., and the PDP Research Group (1986). *Parallel distributed processing. Explorations in the microstructure of cognition: Vol. 2. Psychological and biological models*. Cambridge, MA: MIT Press.

Readings

One copy available at Regenstein Library.

One master copy available for copying only in the Psychology Department.

Lecture Notes

One copy available at Regenstein Library.

One master copy available for copying only in the Psychology Department

Notes for two additional lectures will be available later.

Requirements

Students taking the course pass-fail

- * regular attendance
- * regular presentation of articles during seminars

Students taking the course for a letter grade

* paper (10-20 pages)

1. Categorization Models

Oct. 3 **No class: Centennial**

Readings:

McClelland, J.L., Rumelhart, D.E., & Hinton, G.E. (1986). The appeal of parallel distributed processing. *RM* (pp. 3-44).

Barsalou, L.W., & Hale, C.R. (1991). Components of conceptual representation: From feature lists to recursive frames. Draft of a book chapter in preparation.

2. Interactive Activation Models

Oct. 8 **Lecture: Interactive Activation Models**

Background reading:

Rumelhart, D.E., Hinton, & G.E. McClelland, J.L. (1986). A general framework for parallel distributed processing. *RM* (pp. 45-76).

Oct. 10 **Seminar: Word Recognition in Reading and Speech**

Readings:

McClelland, J.L., & Rumelhart, D.E. (1981). An interactive activation model of context effects in letter perception: Part 1. An account of basic findings. *Psychological Review*, 88, 375-497.

McClelland, J.L., & Elman, J.L. (1986). Interactive processes in speech perception: The TRACE model. *MR* (pp. 58-121).

Oct. 15 **Seminar: Word Recognition in Reading and Speech (cont.)**

Reading:

McClelland, J.L. (1986). The programmable blackboard model of reading. *MR* (pp. 122-169).

3. Associative Nets

Oct. 17 **Lecture: Associative Nets**

Background readings:

Hinton, G.E., McClelland, J.L., & Rumelhart, D.E. (1986). Distributed representations. RM (pp. 77-109).

Hinton, G.E., & Sejnowski, T.J. (1986). Learning and relearning in Boltzmann machines. RM (pp. 282-317).

Oct. 22 **Seminar: Roles of Connectionism in Cognitive Science**

Readings:

Minsky, M. (1991). Logical versus analogical or symbolic versus connectionist or neat versus scruffy. *AI Magazine*, 12, 34-51.

McCloskey, M. (in press). Networks and theories: The place of connectionism in cognitive science. *Psychological Science*.

Oct. 24 **Seminar: Associative Nets in Category and Rule Learning**

Readings:

McClelland, J.L., & Rumelhart, D.E. (1986). A distributed model of human learning and memory. MR (pp. 170-215).

Rumelhart, D.E., & McClelland, J.L. (1986). On learning the past tenses of English verbs. MR (pp. 216-271).

4. Feed Forward, Back Propagation Nets

Oct. 29 **Lecture: Single Layer and Multiple Layer Feed Forward Nets**

Background reading:

Rumelhart, D.E., Hinton, G.E., & Williams, R.J. (1986). Learning internal representations by error propagation. *RM*, (pp. 318-362).

Oct. 31 **Seminar: Single Layer Feed Forward Nets**

Readings:

Gluck, M.A., & Bower, G.H. (1988). Evaluating an adaptive network model of human learning. *Journal of Memory and Language*, 27, 166-195.

Shanks, D.R. (1991). Categorization by a connectionist network. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 433-443.

Nov. 5 **Seminar: Multiple Layer Feed Forward Nets**

Readings:

Sejnowski, T.J., & Rosenberg, C.R. (1986). *NETtalk: A parallel network that learns to read aloud*. Technical Report JHU/EECS-86/01. Department of Electrical Engineering and Computer Science, John Hopkins University. Reprinted in J.A. Anderson & E. Rosenfield (Eds.) (1988), *Neurocomputing: Foundations of research*. Cambridge, MA: MIT Press.

Seidenberg, M.S., & McClelland, J.L. (1989). A distributed, developmental model of word recognition and naming. *Psychological Review*, 96, 523-568.

Nov. 7 **Seminar: Multiple Layer Nets (cont.)**

Readings:

Cohen, J.D., Dunbar, K., & McClelland, J.L. (1990). On the control of automatic processes: A parallel distributed processing account of the Stroop effect. *Psychological Review*, 97, 332-361.

Massaro, D.W. (1988). Some criticisms of connectionist models of human performance. *Journal of Memory and Language*, 27, 213-234.

Nov. 12 **Seminar: Catastrophic Inteference in Feed Forward Nets****Readings:**

McCloskey, M., & Cohen, N.J. (1989). Catastrophic interference in connectionist networks: The sequential learning problem. In G.H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 24, pp. 109-165).

Ratcliff, R. (1990). Connectionist models of recognition memory: Constraints imposed by learning and forgetting functions. *Psychological Review*, 97, 285-308.

5. Representing Structure in Knowledge**Nov.14** **Lecture: Representing Structure in Knowledge****Background readings:**

Fodor, J.A., & Pylyshyn, Z.W. (1988). Connectionism and cognitive architecture: A critical analysis. *Cognition*, 28, 3-71.

van Gelder, T. (1990). Compositionality: A connectionist variation on a classical theme. *Cognitive Science*, 14, 355-384.

Barsalou, L.W. (1991). *Structure and flexibility in human knowledge*. Keynote address, International Conference on Memory, July 1991, Lancaster England.

Nov.19 **Seminar: Semantic Relations and Schemata****Readings:**

Hinton, G.E. (1981). Implementing semantic networks in parallel hardware. In G.E. Hinton & J.A. Anderson (Eds.), *Parallel models of associative memory* (pp. 161-188). Hillsdale, NJ: Erlbaum.

Rumelhart, D.E., Smolensky, P., McClelland, J.L., & Hinton, G.E. (1986). Schemata and sequential thought processes in PDP models. MR (pp. 7-57).

Nov. 21 **Seminar: Structure in Language****Readings:**

McClelland, J.L., & Kawamoto, H. (1986). Mechanisms of sentence processing: Assigning roles to constituents. MR (pp. 272-326).

McClelland, J.L., St. John, M., & Taraban, R. (1989). Sentence comprehension: A parallel distributed processing approach. *Language and Cognitive Processes*, 4, 287-335.

Nov. 26 **Seminar: Structure in Language (cont.)****Readings:**

St. John, M.F., & McClelland, J.L. (1990). Learning and applying contextual constraints in sentence comprehension. *Artificial Intelligence*, 46,217-257.

Miikkulainen, R., & Dyer, M.G. (1991). Natural language processing with modular PDP networks and distributed lexicon. *Cognitive Science*, 15,343-399.

Nov. 28 **No class: Thanksgiving****Dec. 3** **Seminar: Representing Sequential Relations with Recurrent Nets****Readings:**

Elman, J.L. (1990). Finding structure in time. *Cognitive Science*, 14, 179-212.

Mozer, M.C. (1989). A focused backpropagation algorithm for temporal pattern recognition. *Complex Systems*, 3, 349-381.

Dec. 5 **Seminar: Representing Rules****Readings:**

Touretzky, D.S., & Hinton, G.E. (1988). A distributed connectionist production system. *Cognitive Science*, 12, 423-466.

Lamberts, K. (1990). A hybrid model of learning to solve physics problems. *European Journal of Cognitive Psychology*, 2, 151-170.

McMillan, C., Mozer, M.C., & Smolensky, P. (1991). The connectionist scientist game: Rule extraction and refinement in a neural network. *Proceedings of the Thirteenth Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum.

Dec. 10 **Seminar: Representing Structure in Vision****Reading:**

Hummel, J.E., & Biederman, I. (in press). Dynamic binding in a neural network for shape recognition. *Psychological Review*.

6. Conclusion**Dec 12** **Seminar: The Nature of Connectionist Nets****Reading:**

Smolensky, P. (1988). On the proper treatment of connectionism. *The Behavioral and Brain Sciences*, *11*, 1-74. (includes commentary and response)

Questionnaire

(please return in class on Tuesday Oct. 8)

Name _____

Department _____

Phone number _____

Email address _____

Status

_____ graduate student

_____ taking the seminar S/U

_____ taking the seminar for a letter grade

_____ not registered for the course

_____ other (please describe) _____

Briefly describe your background in cognitive psychology:

Briefly describe your background in artificial intelligence:

Briefly describe your background in connectionism:

Preferences for Seminar Presentations

(please return in class on Tuesday Oct. 8

Please list, in order of preference, five seminar readings that you would like to present:

Please describe your general preferences. Please note any specific considerations, such as a preference for formal papers, not for formal papers, for psychological papers, for computational papers, etc.

Please list any days you plan to be absent.

