
Introduction to Cognitive Science

Lecture
Q500, section 1039 - Fall 1998
Tuesday, Thursday: 9:30-10:45, Room 115 Psychology

Laboratory (and Guest Lectures)
Q500, section 1040 - Fall 1998
Wednesday: 7:00-8:30
Room 111 Psychology/155 Hyper

Instructor: Professor Robert Goldstone
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Thursday 2:00-4:00
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Thursday, 10:45-12:00 Office: Lindley hall 406

Readings: IU Bookstore, Indiana Memorial Union

Course Description

This course is intended to give graduate students a exposure to select foundational topics in cognitive science. Cognitive science is an interdisciplinary field devoted to the study of intelligent systems, both natural and artificial. Cognitive science synthesizes research from cognitive psychology, computer science, linguistics, neuroscience, and philosophy. Special attention will be given to: cognitive neuroscience, perception, human learning, concept formation, neural networks, genetic algorithms, consciousness, language, representation, and philosophy of mind. Rather than attempting a broad survey of an impossibly large field, we will delve deeply into a few topics.

Structure of Class Meetings

Although Q500 is technically a lecture course, the class is designed to be a discussion-based course. Loose lectures will be prepared, but the main bulk of the class will depend on your contribution. Class discussions will center on the readings scheduled for the class. Thus, **it is imperative that you do the reading**, or you will have little to discuss. To help you do your reading, you are required to prepare several reaction pages to the assigned readings.

The laboratory section of the class serves two purposes. The first purpose is to provide demonstrations/tutorials of concepts related to the class material. These labs will give you a chance to have active experience with computer programs and with formal methods in cognitive science. The second purpose is to expose you to current cognitive science research as it done at Indiana University. Several guest lecturers will give presentations of their research. In some cases, they have requested that you read one of their articles in preparation for their talk.

Grading

Breakdown of grade:

Exam I - 22%
Exam II - 22% (non-cumulative)
Reaction Pages- 34%
Reactions pages for 16+ out of 25 readings = A
14-15 = B
12-13 = C
10-11 = D
<10 = F
Laboratory participation and homework (Apparent Motion, Feature Search, Interactive Activation Lab, Neural Networks, Genetic Algorithms, and Starlogo)- 22%

Exams. Exams will consist of essay questions. You are responsible for everything covered in the readings and in the lectures. An attempt will be made to design questions that test your knowledge of general concepts and definitions, underlying principles, and important experimental methods and results. You should study and read for comprehension as opposed to brute memorization. A typical essay question might be "What problems do normative models of human decision making have? Are normative models still viable? Why or why not?" During each exam, you will answer approximately 6 questions that require about 2 paragraphs each, and you may be given one or two slightly longer questions to work on overnight.

Reaction Pages. The purpose of the weekly reaction page requirement is for students to develop perspectives on their readings before class. You are required to prepare 17 one-page reaction pages in total. If you decide to prepare a reaction page for a reading, it must be handed in by the end of the class for which it was assigned. Late reaction pages will not be accepted (the point of the reaction page is to have students think about the issues involved before the class). Reaction pages will be coarsely graded (unacceptable, acceptable, and a rarely used "outstanding") and will receive very brief comments from me (mostly checks, "X"s, and "?"s). The assignment is purposefully open-ended. Appropriate topics for reaction pages may be suggested, but most often, you will be left to select for yourself an interesting topic that relates to the readings in some way.

The reaction pages will be made available to other students in the class via the web program Annotate. You should submit your paper via the web before the beginning of the class that covers the paper. Other students will not be able to read your reaction page until after the class, and students will not be able to submit papers after class. Students can, however, read all other students' papers, and make publically accessible comments attached to these papers.

Space should be considered a scarce resource. You should try to be refine your thoughts such that they can be concisely expressed on a single page (I will, however, accept multi-page reactions). The most successful reaction pages focus on a single topic. Resist the temptation to write a few sentences each on four topics.

What are appropriate topics for reaction pages? You may develop an experiment or model that is inspired by one of the readings. You may disagree with a particular idea. Explain why the idea is wrong, and why it is important that it is wrong. You may agree with a idea. Describe extensions to the idea, possible applications, or future directions for research. You may have nothing to say about a particular article. If so, explain why the article is not relevant to fundamental issues of cognitive science. Discuss the assumptions of the article, and why you find them inappropriate.

Disclaimer. This syllabus is not definitive. Course policies are subject to change at any time. You will be notified of any changes.

Getting the most out of the class. This course should be one of the most important and interesting courses you take. The following pointers can help to ensure this.

1. *Question your professor, and your readings*. True knowledge only comes from an active engagement of the material. Questions in class are welcome, and prolonged class discussions should be looked upon as learning opportunities rather than digressions.
2. *Explain the material to yourself.* Don't expect the material to seep its way into your head; you must actively carry it in.
3. *Apply principles to your everyday life and your other interests.*
4. *Try to appreciate the deep, underlying issues.* Data and experiments are important; getting the details right is critical. But, also consider the motivation, assumptions, and implications of the results.
5. *View the field as ongoing investigations, not as solved puzzles.*
6. *Visit me outside of class.* I am eager to meet any students to discuss cognitive science broadly construed.

Class schedule

Date	Topic and Reading	Location
TU 9/1	Introduction, expectations, policies, overview	115 Psych.
WE 9/2	Using Annotate and other computer Qs	155 Hyper
TH 9/3	Cognitive Neuroscience Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (1998). Cognitive Neuroscience. New York: Norton & Company. Chapter 5. (pp. 163 - 206).	115 Psych.
TU 9/8	Cognitive Neuroscience Nestor, P. G., & O'Donnell, B. F. (1998). The mind adrift: Attentional dysregulation in schizophrenia. in R. Parasuraman (Ed.) The Attentive Brain. Cambridge, MA: MIT Press. (pp. 527-546).	115 Psych.
WE 9/9	Lecture: Brian O'Donnell	111 Psych.
TH 9/10	Cognitive Neuroscience Damasio, H., Grabowski, T. J., Tranel, D., Hichwa,, R. D., & Damasio, A. R. (1996). A neural basis for lexical retrieval. Nature, 380, 499-505.	115 Psych.

TU 9/15	Perception Ramachandran, V. S., & Anstis, S. M. (1986). The perception of apparent motion. Scientific American, June, 102-109.	115 Psych.
WE 9/16	Lab: Apparent Motion	155 Hyper
TH 9/17	Pattern Perception Treisman, A. (1986). Features and objects in visual processing. Scientific American, November, 114-125.	115 Psych.
TU 9/22	Pattern Perception 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, 375-407.	115 Psych.
WE 9/23	LAB: Feature Search Feature Search lab description **Apparent Motion Lab Due**	???????????
TH 9/24	Concept Learning Posner, M. I., & Keele, S. W. (1968). On the genesis of abstract ideas. Journal of Experimental Psychology, 77, 353-363.	115 Psych.
TU 9/29	Medin, D. L. (1989). Concepts and conceptual structure, American Psychologist, 44, 1469-1481.	115 Psych.
WE 9/30	Lecture: Robert Nosofsky **Feature Search Lab Due**	111 Psych
TH 10/1	Machine Learning Firebaugh, M .W. (1988). Artificial Intelligence. Boston: Boyd & Fraser. Chapter 17, 578-608.	115 Psych.
TU 10/6	Neural Networks: Constraint Satisfaction Rumelhart, D. E., Smolensky, P., McClelland, J. L., & Hinton, G. E. (1986). Schemata and sequential thought processes in PDP models. in J. McClelland & D. Rumelhart (eds.) Parallel Distributed processes: Explorations in the Microstructure of Cognition, Vol. 2. Cambridge: MIT Press. (pp. 7-32).	115 Psych.
WE 10/7	LAB: Interactive Activation Model	??????????

TH 10/8	Neural Networks Without Learning Rumelhart, D. E., Smolensky, P., McClelland, J. L., & Hinton, G. E. (1986). Schemata and sequential thought processes in PDP models. in J. McClelland & D. Rumelhart (eds.) Parallel Distributed processes: Explorations in the Microstructure of Cognition, Vol. 2. Cambridge: MIT Press. (pp. 33-57).	115 Psych.
TU 10/13	Neural Network Architectures Rumelhart, D. E. (1989). The architecture of mind: A connectionist approach. in M. I. Posner (ed.) Foundations of Cognitive Science. Cambridge: MIT Press. (pp. 133-160).	115 Psych.
WE 10/14	LAB: Supervised Neural Networks **Interactive Activation Lab Due**	??????????
TH 10/15	Neural Networks: Unsupervised Learning Rumelhart, D. E., & Zipser, D. (1985). Feature discovery by competitive learning. in D. Rumelhart & J. McClelland (eds.) Parallel Distributed processes: Explorations in the Microstructure of Cognition, Vol. 1. Cambridge: MIT Press. (pp. 151-193).	115 Psych.
TU 10/20	Machine Learning Systems	115 Psych.
WE 10/21	TUTORIAL: Review Session **Neural Network Lab Due**	111 Psych.
TH 10/22	MID-TERM EXAM	115 Psych.
TU 10/27	Genetic Algorithms Mitchell, M. (1996). An Introduction to Genetic Algorithms. Cambridge, MA: MIT Press. (pp. 1-31).	115 Psych.
WE 10/28	Lab: Genetic Algorithms	??????????
TH 10/29	Koza, J. R. (1990). Evolution and co-evolution of computer programs to control independently-acting agents. In Meyer, J., & Wilson, S. W. From Animals to Animats: Proceedings of the First International Conference on Simulation of Adaptive Behavior. Cambridge, MA: The MIT Press. (pp. 366-375).	115 Psych.

TU 11/3	Genetic Algorithms and Evolution Hinton, G. E., & Nowlan, S. J. (1987). How learning can guide evolution. Complex Systems, 1, 495-502.	115 Psych.
WE 11/4	Lab: StarLogo & Distributed Computing **Genetic Algorithms Lab Due**	??????????
TH 11/5	Complex Adaptive Systems Murray, J. D. (1993). How the leopard gets its spots. Scientific American, June, 80-87.	115 Psych.
TU 11/10	Consciousness Jacoby, L. L., & Kelley, C. M. (1992). A process-dissociation framework for investigating unconcsious influences: Freudian slips, projective tests, subliminal perception, and signal detection theory. Current Directions in Psychological Science, 1, 174-179.	115 Psych.
WE 11/11	No Lab	
TH 11/12	**Starlogo Lab Due** Consciousness Chalmers, D. J. (1995). The puzzle of consciousness. Scientific American, December, 80-86. Dennett, D. C. (1991). Consciousness explained. Boston: Little, Brown, and Co. Chapter 5 (pp. 101-138).	115 Psych.
TU 11/17	Language Pinker, S. (1991). Rules of language. Science, 253, 530-535.	115 Psych.
WE 11/18	No lab	
TH 11/19	Representation Palmer, S. E. (1978). Fundamental aspects of cognitive representation. In E. Rosch & B. B. LLoyd (Eds.), Cognition and categorization. (pp. 259-303). Hillsdale, NJ: Lawrence Erlbaum Associates.	115 Psych.
TU 11/24	Thanksgiving	home
WE 11/25	Thanksgiving	home
TH 11/26	Thanksgiving ("I think, therefore I yam")	home

TU 12/1	Knowledge Representation in A.I. Firebaugh, M .W. (1988). Artificial Intelligence. Boston: Boyd & Fraser. Chapter 9, 274-299.	115 Psych.
WE 12/2	Lecture: Douglas Hofstadter	111 Psych.
TH 12/3	Knowledge Representation in A.I. Mitchell, M., & Hofstadter, D. R. (1990). The emergence of understanding in a computer model of concepts and anlogy-making. Physica D, 42, 322-334.	115 Psych.
TU 12/8	Representations (or lack thereof) Brooks, R. A. (1997). Intelligence without representation. In J. Haugeland (Ed.) Mind Design II. Cambridge, MA: MIT Press. (pp. 395-420).	115 Psych.
WE 12/9	Lecture: Robert Port	111 Psych.
TH 12/10	Philosophy of Mind Harnad, S. (1990). The symbol grounding problem. Physica D, 42, 335-346.	115 Psych.
TH 12/17	FINAL EXAM10:15-12:15	115 Psych.