

Psych/Ling/Phil/CS&E 612

Introduction to Cognitive Science

Course Syllabus, Winter 2012

Course:	Psych 612
Call number:	24739
Credits:	3
Dates:	Jan 4–March 14, 2012
Times:	Mondays and Wednesdays 09:30–11:18 a.m.
Room:	Stillman Hall, Room 131
Prerequisites:	Graduate standing, permission of instructor, or at least 12 credit hours from at least two of the following five areas: computer science, linguistics, neuroscience, philosophy, and psychology.
Websites:	https://carmen.osu.edu and http://alexpetrov.com/teach/cogintro/
Textbook:	José Luis Bermúdez (2010). <i>Cognitive Science: An Introduction to the Science of the Mind</i> . Cambridge, UK: Cambridge UP. ISBN 978-0-521-70837-1. http://www.cambridge.org/features/bermudez/
Instructor:	Dr. Alexander Petrov (614) 247-2734 petrov.11@osu.edu 200B Lazenby Hall Office hours: M, W 11:20–12:00

Course Overview

What is cognition and how does it emerge from the brain? This course introduces you to the exciting interdisciplinary field of cognitive science. Researchers in philosophy, neuroscience, psychology, artificial intelligence, and linguistics realized that they were asking many of the same questions about the nature of the human mind/brain, that they had developed complementary and synergistic methods of investigation, and that the evidence led them to compatible answers to their questions. This course introduces cognitive science through a representative sample of such questions, methods, and answers. It is not a special-topic course for students who seek detailed knowledge in a specific area of cognitive science. We will try not to lose sight of the forest for the trees but we will take a closer look at a few trees too because science is in the details. Along the way, we will introduce the constituent disciplines and their respective contributions to the study of cognition. We will discuss the foundational concepts of *computation* and *representation* from multiple points of view. Three unifying themes are emphasized throughout: 1. Information processing: The mind/brain is viewed as a complex system that receives, stores, retrieves, transforms, and transmits information. 2. Neurological grounding: Explicit effort is made to show how mental phenomena emerge from the interactions of networks of neurons in the brain. 3. Cognitive architecture: The emphasis is on functionally complete systems rather than disjoint empirical phenomena.

Intended Audience. Prerequisites

This course is cross-listed in the Departments of Computer Science and Engineering, Linguistics, Philosophy, and Psychology. It is intended for graduate and advanced undergraduate students in these departments. Interested students from related areas (notably neuroscience) are welcome too. The formal prerequisites for taking the course are: graduate standing in any of these departments **or** permission of the instructor **or** at least 12 undergraduate-level credit hours from any of the four disciplines. The informal prerequisites are: willingness to step outside the confines of one's area of specialization, willingness to read the professional literature (as opposed to textbooks) with help from the instructor and one's peers, willingness to participate in open discussions, and the ability to write clearly and concisely about topics outside one's area of specialization.

Course Objectives

Upon successful completion of the course, the students will:

- Appreciate the interdisciplinary nature of cognitive science, the diversity of viewpoints, the controversies and the areas of nascent consensus.
- Be exposed to the contribution of each of the five constituent disciplines and be familiar with its methods, key concepts, and focus of investigation.
- Be proficient in the *lingua franca* of cognitive science—the language of information processing.
- Have basic familiarity with brain anatomy and physiology.
- Master multiple definitions of the foundational concepts of *computation* and *representation* and be able to discuss them from multiple points of view.
- Understand the basic cognitive architecture—how perception, memory, language, motor control, and so forth come together to produce adaptive behavior.
- Know a multitude of specific concepts, theories, and experimental results covered in course. The lecture plan below lists some relevant keywords.
- Be able to read and discuss research papers from multiple disciplines.
- Be able to write critical essays on topics outside one's area of specialization.

Course Materials

The main textbook is *Cognitive Science: An Introduction to the Science of the Mind* (Bermúdez, 2010, Cambridge UP). Various learning resources are provided on the accompanying website <http://www.cambridge.org/features/bermudez/>. We will supplement the textbook with additional readings listed in the bibliography below. All required readings (except the textbook itself) are posted in PDF on the Carmen website <https://carmen.osu.edu/>

Teaching Method

As we will learn in the course, people remember much better when they study on a regular basis rather than cramming for a final exam. Also, people remember better when they actively process the material rather than just sit and listen. The course organization capitalizes on these important properties of memory. In addition to the lectures, it is arranged that you read something every week, discuss something every week, and write

something every other week. In addition to the main textbook, the course is organized around five *target articles*. Some of them are classic publications in the research literature that have stood the test of time and are recognized to have lasting value and importance in cognitive science. Other target articles are recent reviews or reports of cutting-edge research. You are required to read each target article carefully before its assigned date in the calendar below and come to class prepared to discuss it in detail. For three specific target articles designated in the *Course Calendar* below, you will also be required to write a 500-word summary paper.

Evaluation

Your grade will depend on three components in the following proportions:

- Summary papers (3 papers worth 60 points each) 180
- Midterm Exam (Wednesday 2/08, 9:30 am, Stillman 131) 360
- Final Exam (Wednesday 3/14, 9:30 am, Stillman 131) 460

Grades are based on absolute cutoffs: A=900-1000, B=800-899, C=700-799, D=600-699, E<600 points, respectively.

Summary papers: Eighteen percent of your final grade will be based on your summary papers of the 3 target articles listed in the *Course Calendar* below. Each summary paper contributes up to 60 points toward your final grade.

Guidelines for writing good summary papers:

- Each summary paper must be 400–600 words long and must be double-spaced, properly formatted, and proofread. No separate title page is required. On the upper-left corner of the first page, write the title of the target article, your name, submission date, and the number of words.
- The paper will be graded as a weighted sum of scores on three categories:
 - 50%: Ability to identify the main points of the target article and summarize them correctly and concisely.
 - 30%: Ability to critically examine the target article in your own terms.
 - 20%: General understanding of the concepts and issues involved; clarity of presentation (organization, clear writing, paper format).
- The *Discussion Topics* section of the *Content* area on Carmen lists additional guidelines specific for each target article.
- Note that PSY 612 is not a writing course and hence extensive editorial or stylistic comments on your summaries will not be offered.

Each summary paper must be submitted in electronic form on the Carmen website (<https://carmen.osu.edu/>). There are 3 Dropboxes—one for each target article. Your papers must be uploaded to the corresponding Dropbox in MS Word (.docx or .doc), plain text (.txt), PDF, HTML, or RTF format. Assignments in other formats are not acceptable and will not be graded. In particular, .wps, .wpd, and .odt files are not supported. **The only way to submit your homework is to upload it to its corresponding Dropbox on Carmen.** Files dropped in a wrong Dropbox, sent by email, slipped under a door, and so on will not be accepted without prior permission. The

Course Calendar lists two submission deadlines for each target article. The first deadline is for a preliminary draft that must be submitted before the article in question is discussed in class. The second deadline – five days after the corresponding discussion – is for the final version of the same summary paper. Then the Dropbox for this target article closes and there is no way to obtain credit for this assignment. Your points will be based primarily on the final versions of your summary papers, although the preliminary drafts will also be looked at. The preliminary drafts should be detailed enough and specific enough to convince the instructor that you have read and thought about the target article before the class discussion. The final version is expected to polish the arguments already present in the preliminary draft.

Attendance and participation in discussions: Participation in the class discussions is an integral element of this course. Attending the lectures is strongly encouraged.

Exams: The Midterm Exam (2/08) and the Final Exam (3/14) are closed-book and consist of short-answer and essay questions. Sample questions will be given in class. The exams are not cumulative, except that the topics covered in the second half of the course depend on concepts and facts introduced in the first half. No make-up exams will be given, except in the case of documented illness or emergency. All make-up exams will be oral. In the event of a last-minute emergency, you **must** call Dr. Petrov (614-247-2734) or the office associate for the cognitive area (Sheena Riepenhoff, 614-292-1123) **on the same day as the exam**, preferably before the exam begins. Acceptable excuses for missing an exam are a death in your family, personal illness or the illness of your child or spouse, and unforeseen accidents like your car breaking down or getting stuck in an elevator. Please obtain documented proof of these events should they occur. If you are late for an exam, you will be allowed to take it but you will have to submit your answers by the closing time like everybody else.

Academic Ethics

All students enrolled in OSU courses are bound by the Code of Student Conduct (http://studentaffairs.osu.edu/resource_csc.asp). The instructor and course assistants are committed to maintaining a fair assessment of student performance in this course. Suspected violations of the Code will be dealt with according to the procedures detailed in the Code. Specifically, any alleged cases of misconduct will be referred to the Committee on Academic Misconduct.

There are two major ethical considerations in this course. First, all exams are closed book. No notes may be used during the examinations and you may not confer with your fellow students or look at their exam booklets for answers during the exam period. Prior to the examinations, you are encouraged to study in small groups. However, once you enter the examination room, you are expected to work alone. Second, you are expected to work alone on your homework assignments. You may not turn in anything that you did not *completely* write. Be careful about plagiarism: attribute quotes and ideas that others have previously published where appropriate. A very comprehensive website that describes most aspects of plagiarism has been produced by Northwestern University (<http://www.northwestern.edu/provost/students/integrity/plagiarism.html>).

Accommodations for Students with Special Needs

The policy of The Ohio State University is to provide every reasonable, appropriate, and necessary accommodation to qualified disabled students. The University's colleges and academic centers evaluate and judge applications on an individual basis and no categories of disabled individuals are automatically barred from admission. The privacy rights of each disabled person are honored to the fullest extent possible. The University's interest in a student's disabilities are only for the purpose of accommodating his/her specific disability, thereby providing an academically qualified disabled student access to programs and activities accorded all other qualified students. Whenever generally accessible facilities do not adequately accommodate a specific disability, the University makes every reasonable accommodation and program or facility adjustment to assure individual access. These policies are fully supported and practiced in this class.

If you have a disability documented with the Office of Disability Services (<http://www.ods.ohio-state.edu>, 150 Pomerene Hall, 614-292-3307), please contact Dr. Petrov privately (petrov.11@osu.edu, 200B Lazenby Hall, 614-247-2734) by the end of the second week of classes (1/15/2012) so that any accommodations can be made.

Course Calendar

1. **W 01/04 – Introduction.** Course organization, exam dates, etc. Motivation: Newell's big question. Constituent disciplines. Interdisciplinary approach. **Philosophy I.** The ship of Theseus. Unchanging essences and forms. Mind-body problem. Substance dualism. Reading: Textbook Section 4.1.
2. **M 01/09 – Mind-body problem.** Descartes' epistemological argument. Problems with Cartesian dualism. Mental causation. Epiphenomenalism. Phineas Gage. Physicalism. Reading: TBA.
3. **W 01/11 – Linguistics.** Components of a grammar. Chomsky. Syntax, constituents, (formal) grammars. Productivity. Recursion. Semantics. Language of thought. Readings: Whitney (1998), Textbook Chapter 1 and Section 6.2.
M 01/16 – Martin Luther King Day: No classes
4. **W 01/18 – Formal systems. Finite State Machines.** Logic: Aristotle, Boole, Frege. Automatic formal systems. Digital circuits. Finite state automata. Turing machine. **Preliminary draft of short paper #1 due 01/22.** Readings: Haugeland (1997), Turing (1950).
5. **M 01/23 – Turing Machines. Turing Test.** Tribute to Alan Turing. Discussion of Turing (1950), *Computing machinery and intelligence*. Universal Turing Machine. **Final version of short paper #1 due 01/28.** Readings: Haugeland (1985), Textbook Sections 1.3 and 3.1.
6. **W 01/25 – Classical View of Information Processing. Artificial Intelligence.** Weak versus strong AI. Subfields, applications, and recent trends in AI. SHRDLU (Winograd, 1972). Physical symbol systems (Newell & Simon, 1976).

- Efflorescence of adaptation (Newell, 1990). GOFAI and its limitations. Readings: Newell (1990), Textbook Section 2.1 and Chapters 6 and 7.
7. **M 01/30 –Neuroscience I: Brain anatomy. Hippocampus. Decorticate animals. Amnesic patients H.M. and Clive Wearing. Functional magnetic resonance imaging (fMRI).** Readings: Eichenbaum (2002), Baars & Gage, (2010, Ch. 5), Textbook Chapters 3 and 11 and Sect. 4.5.
 8. **W 02/01 – Neuroscience II. Neuron doctrine. Neurophysiology. Ion channels. Action potentials. Synaptic transmission. Computational cognitive neuroscience. Integrate-and-fire neurons. Point neuron approximation. Preliminary draft of short paper #2 due 02/05.** Reading: Baars & Gage (2010, Ch. 3); McClelland, Rumelhart, & Hinton (1986).
 9. **M 02/06 – Parallel Distributed Processing.** Multiple realizability? Brain-style computation. Discussion of McClelland, Rumelhart, & Hinton (1986). *The appeal of PDP*. Simulated (linear) neuron. *Emergent* simulator. Constraint satisfaction. Cats-and-dogs demo. **Final version of short paper #2 due 02/11.** Reading: Textbook Chapters 3 and 8.
 10. **W 02/08 – Midterm Exam** – Short- and long-answer questions covering lectures 1–9 and the associated readings. Same time and place (9:30-11:18, Stillman 131).
 11. **M 02/13 – Hebbian Learning. Biological Basis of Learning.** Cajal’s synaptic plasticity hypothesis. Hebbian learning rule. Long-term potentiation (LTP) and depotentiation (LTD). NMDA receptors. Role of LTP/LTD in learning and memory. Synaptic consolidation. Reading: Baars & Gage (2010, Ch. 3). Textbook Sections 4.2, 4.3, and 5.1.
 12. **W 02/15 – Error-Correcting Learning.** Pattern associator. Limitations of Hebbian learning. Input/ output mapping task. Navlab demo. Delta rule. XOR problem. Hidden layers Generalized delta rule (error backpropagation). Networks are universal function approximators. Reading: McClelland, Rumelhart, & Hinton (1986), Textbook Chapters 8 and 9.
 13. **M 02/20 – Multiple Memory Systems. Prefrontal Cortex.** Localist versus distributed representations. Generalization. Distributed memories. Content-addressable memory. Complementary learning systems. Hippocampal-cortical model. Consolidation. Reading: <http://grey.colorado.edu/CompCogNeuro/index.php/CCNBook/Memory> .
 14. **W 02/22 – Working Memory and Executive Control.** Baddeley’s working memory model. Central executive. Stroop effect. Wisconsin card sorting task. Delayed non-match-to-sample task. Active memory in prefrontal cortex (PFC). Cohen et al (1990) model of the Stroop effect. **Preliminary draft of short paper #3 due 02/26.** Readings: Textbook Section 5.1. <http://grey.colorado.edu/CompCogNeuro/index.php/CCNBook/Executive>
 15. **M 02/27 – Cognitive Architectures I: Integration.** Newell’s big question. Horizontal and vertical integration. Modularity of mind. Introduction to ACT-R architecture. Discussion of Anderson & Lebiere (2003), *The Newell Test for a*

- theory of cognition. Final version of short paper #3 due 03/03.* Readings: Newell (1990), Anderson (2007), Textbook Chapter 5 and Sections 2.3 and 3.1.
16. **W 02/29 – Cognitive Architectures II: ACT-R.** Production systems. Declarative and procedural memories in ACT-R. Serial and parallel processing. Symbolic and subsymbolic levels. Learning in ACT-R. End-to-end behavior example. Readings: Anderson (2007). Textbook Chapter 10.
 17. **M 03/05 – Cognitive Architectures III. Synthesis of ACT-R and Leabra. Behavior-Based Robotics.** ACT-R and the brain. Banishing the homunculus. Gating in PFC and the basal ganglia. Tripartite architecture. SAL: Synthesis of ACT-R and Leabra. Perception-action cycle. Change blindness. Intelligence without representation. Subsumption architecture and behavior-based robotics. Rodney Brooks demos. Readings: Anderson (2007), Jilk et al. (2008), Textbook Chapter 13.
 18. **W 03/07 – Universality Revisited. Integration. Conclusions.** Review of Turing Machines (TM) and Universal TM. Is human cognition universal? Controlled versus automatic processing. Unity and diversity of cognitive science. Looking ahead. Final discussion. Readings: Haugeland (1985), Textbook Chapter 14.
 19. **W 03/14 – Final Exam** – Same time, same place (9:30-11:18, Stillman 131).

The above calendar is subject to change at the discretion of the instructor, depending on the rate of progress through the material, student interest in alternative topics, and/or scheduling constraints.

Additional Readings

In addition to Bermúdez' (2010) textbook, which is the main text for this course, the following required readings supplement and amplify some topics of particular importance. All of the following items are available on Carmen in PDF format. The list of readings is subject to change at the discretion of the instructor.

1. Anderson, John R. (2007). Cognitive architecture. Chapter 1 in *How can the human mind occur in the physical universe?* (pp. 3-39). New York: Oxford University Press.
2. Anderson, John R. & Lebiere, Christian (2003). The Newell Test for a theory of cognition. *Behavioral and Brain Sciences*, 26, 587-640. **Discussion paper #3: preliminary draft due 02/26, final version due 03/03.** [Read the target article, the commentary by McClelland et al, and the *Authors' Response*.]
3. Baars, Bernard J. and Gage, Nicole M. (2010, Ch.3). Neurons and their connections. Chapter 3 in *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience* (2nd Ed.). New York: Academic Press.
4. Baars, Bernard J. and Gage, Nicole M. (2010, Ch.5). The brain. Chapter 5 in *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience* (2nd Ed.). New York: Academic Press.
5. Haugeland, John (1985). Computer architecture. Chapter 4 in *Artificial Intelligence: The Very Idea*. MIT Press. ISBN 0-262-58095-0.

6. Haugeland, John (1997). What is mind design? In J. Haugeland (Ed.), *Mind Design II: Philosophy, Psychology, Artificial Intelligence*. Cambridge, MA: MIT Press.
7. Jilk, D. J., Lebiere, C., O'Reilly, R. C., & Anderson, J. R. (2008). SAL: An explicitly pluralistic cognitive architecture. *Journal of Theoretical Artificial Intelligence*, 20 (3), 197-218. [SAL stands for "Synthesis of ACT-R and Leabra."]
8. McClelland, J. L., Rumelhart, D. E., & Hinton, G. E. (1986). The appeal of Parallel Distributed Processing. In D. E. Rumelhart, J. L. McClelland, and the PDP Research Group (Eds.), *Parallel Distributed Processing: Explorations in the Microstructure of Cognition, Vol. I: Foundations* (pp. 3-44). **Discussion paper #2: preliminary draft due 02/05, final version due 02/11.**
9. Newell, Allen (1990). Human cognitive architecture (pp. 111-131). Excerpt from Chapter 3 in *Unified Theories of Cognition*. Cambridge, MA: Harvard Univ. Press.
10. Turing, Alan M. (1950). Computing machinery and intelligence. *Mind*, 59, 433-460. [Available on-line <http://loebner.net/Prize/TuringArticle.html>] **Discussion paper #1: preliminary draft due 01/22, final version due 01/28.**
11. Whitney, P. (1998). What language users must know (pp. 31-71). Chapter 2 in *The Psychology of Language*. Boston, MA: Houghton Mifflin Co.

Optional Readings

The following were used as (required) additional readings in previous installments of this course, but were dropped to save time. They still are great articles, though, and you may want to check them out. PDFs are available on Carmen.

12. Eichenbaum, Howard (2002). Amnesia: Learning about memory from memory loss. Chapter 1 in *The Cognitive Neuroscience of Memory: An Introduction*. Boston, MA: Oxford University Press. This used to be a discussion paper in previous installments of this course. Please read it prior to the lecture on amnesia (01/30). You do not have to write a summary paper about it, though.
13. Feldman, Jerome (2006). The language wars. Chapter 22 in *From Molecule to Metaphor: A Neural Theory of Language* (pp. 271-282). Cambridge, MA: MIT press.
14. Mitchell, T. M., Shinkareva, S. V., Carlson, A., Chang, K.-M., Malave, V. L., Mason, R. A., & Just, M. A. (2008). Predicting human brain activity associated with the meanings of nouns. *Science*, 320, 1191-1195. This used to be a discussion paper in previous installments of this course. Please read it prior to the lecture on fMRI and multivoxel pattern analysis (01/30). You do not have to write a summary paper about it, though. The supplementary material (also posted on Carmen) is optional.
15. Romo, Ranulfo & Salinas, Emilio (2003). Flutter discrimination: Neural codes, perception, memory and decision making. *Nature Reviews Neuroscience*, 4, 203-218.
16. Senghas, A., Kita, S., & Özyürek, A. (2004). Children creating core properties of language: Evidence from an emerging sign language in Nicaragua. *Science*, 305, 1779-1782.

Recommended Books

If you want to learn more, the following books are good, thoughtful starting points:

1. Abelson, Harold & Sussman, Gerald Jay (1996). *Structure and interpretation of computer programs* (2nd Ed.). MIT Press. [Arguably the best introduction to functional programming and consequently (though indirectly) to physical symbol systems (cf. Newell & Simon, 1976).]
2. Anderson, John R. (2004). *Cognitive Psychology and Its Implications* (6th Ed.). New York: Worth Publishers. ISBN 0716701103.
3. Anderson, John R. (2007). *How can the human mind occur in the physical universe?* New York: Oxford University Press. ISBN 978-0-19-532425-9.
4. Baars, Bernard J. and Gage, Nicole M. (2010). *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience* (2nd Ed.). New York: Academic Press. ISBN 978-0-12-375070-9.
5. Bechtel, William (2008). *Mental Mechanisms: Philosophical Perspectives on Cognitive Neuroscience*. New York: Routledge. ISBN 0-8058-6334-6.
6. Blackmore, Susan (2011). *Consciousness: An Introduction* (2nd Ed.). New York: Oxford University Press. ISBN 0199739099.
7. Carroll, David W. (2008). *Psychology of Language* (5th Ed.). Belmont, CA: Thompson. ISBN 0-495-09969-4.
8. Chalmers, David J. (Ed.) (2002). *Philosophy of Mind: Classical and Contemporary Readings*. New York: Oxford University Press. ISBN 0-19-514581.
9. Churchland, Patricia S. & Sejnowski, Terrence J. (1994). *The Computational Brain*. MIT Press. ISBN 0-262-53120-8.
10. Dawson, Michael (1998). *Understanding Cognitive Science*. Malden, MA: Blackwell Publishers. ISBN 0-631-20894-1.
11. Dennett, Daniel C. (1981). True believers: The intentional strategy and why it works. In A. F. Heath (Ed.), *Scientific Explanation*, Oxford: Oxford University Press. [Reprinted in Haugeland (1997) and Chalmers (2002).]
12. Eichenbaum, Howard (2002). *The Cognitive Neuroscience of Memory: An Introduction*. Boston, MA: Oxford University Press. ISBN 978-0-19-514175-7.
13. Feynman, Richard (1984/1996). *Feynman Lectures on Computation* (Edited by T. Hey and R. W. Allen). Cambridge, MA: Perseus Publishing. ISBN 0-7382-0296-7.
14. Flanagan, Owen (2007). *The really hard problem: Meaning in a material world*. Cambridge, MA: MIT Press. ISBN 987-0-262-06264-0.
15. Forbus, Kenneth (2010). AI and Cognitive Science: The past and next 30 years. *Topics in Cognitive Science*, 2, 345-356. [Special issue on the 30th Anniversary of the founding of the Cognitive Science Society. The same issue also has good commentaries on several other constituent disciplines.]

16. Ford, K. & Hayes, P. (1998). On computational wings: Rethinking the goals of AI. *Scientific American Presents*, 9 (4), 78-83. [Special issue, "Exploring Intelligence". This article presents a compelling analogy between artificial intelligence and artificial flight and argues that the proper goal of AI is not to imitate human intelligence, just as aeronautics does not imitate bird flight.]
17. Friedenberg, Jay & Silverman, Gordon (2012). *Cognitive Science: An Introduction to the Study of the Mind* (2nd Ed.). Thousand Oaks, CA: Sage Publications. ISBN 978-1-4129-7761-6. [Comprehensive but superficial. Basically, it's a giant glossary.]
18. Thagard, Paul (Ed.) (2007). *Philosophy of Psychology and Cognitive Science*. Amsterdam: Elsevier. ISBN 978-0-444-51540-7.
19. Gluck, M. A., Mercado, E., & Myers, C. E. (2008). *Learning and Memory: From Brain to Behavior*. New York: Worth Publishers. ISBN 0-7167-8654-0.
20. Harris, D. M. & Harris, S. L. (2007). *Digital Design and Computer Architecture*. San Francisco, CA: Morgan Kaufmann. ISBN 0-12-370497-9.
21. Haugeland, John (1985). *Artificial Intelligence: The Very Idea*. MIT Press. ISBN 0-262-58095-0.
22. Haugeland, John (Ed.) (1997). *Mind Design II: Philosophy, Psychology, Artificial Intelligence* (2nd Ed.). Cambridge, MA: MIT Press. ISBN 0-262-58153-1.
23. Haykin, Simon (2009). *Neural Networks and Learning Machines* (3rd Ed.). New York: Prentice Hall. ISBN 978-0-13-603219-9.
24. Hofstadter, Douglas R. (1985). Review of *Alan Turing: The Enigma*. Chapter 12 in *Metamagical Themas: Questing for the Essence of Mind and Pattern* (pp. 483-491). Basic Books.
25. Huettel, S. A., Song, A. W., & McCarthy, G. (2008). *Functional Magnetic Resonance Imaging* (2nd Ed.). Sinauer. ISBN 0878932860.
26. Kim, Jaegwon (2006). *Philosophy of Mind* (2nd Ed.). Cambridge, MA: Westview. ISBN 0-8133-4269-4.
27. Kolb, Brian & Whishaw, Ian (2008). *Fundamentals of Human Neuropsychology* (6th Ed.). New York: Worth Publishers. ISBN 0-7167-9586-8.
28. Kolb, Brian & Whishaw, Ian (2006). *An Introduction to Brain and Behavior* (2nd Ed.). New York: Worth Publishers. ISBN 0-7167-1187-7.
29. Komatsu, Lloyd K. (Ed.) (1994). *Experimenting with the Mind: Readings in Cognitive Psychology*. Pacific Grove, CA: Brooks/Cole Publishing Co. ISBN 0-534-21600-5.
30. Lakoff, George & Johnson, Mark (1980). *Metaphors We Live By*. Chicago: The University of Chicago Press. ISBN 0-226-46801-1.
31. LeDoux, Joseph (2002). *The Synaptic Self: How Our Brains Become Who We Are*. New York: Viking Penguin. ISBN 0-670-03028-7.
32. Levitin, Daniel J. (Ed.) (2011). *Foundations of Cognitive Psychology: Core Readings*. Boston, MA: Allyn & Bacon. ISBN 978-0-205-71147-5.

33. Markman, Arthur B. (1999). *Knowledge Representation*. New York: Psychology Press. ISBN 978-0-8058-2441-4.
34. McClelland, James L. (2000). Connectionist models of memory. In E. Tulving & F. Craik (Eds.), *The Oxford Handbook of Memory* (pp. 583-596). Oxford Univ. Press.
35. Newell, Allen (1990). *Unified Theories of Cognition*. Cambridge, MA: Harvard University Press. ISBN 0-674-92099-6.
36. O'Grady, W., Archibald, J., Aronoff, M., & Rees-Miller, J. (2005). *Contemporary Linguistics: An Introduction* (5th Ed.). New York: Bedford/St. Martin's. ISBN 0-312-41936-8.
37. O'Reilly, Randall C. (1998). Six principles for biologically based computational models of cortical cognition. *Trends in Cognitive Sciences*, 2 (11), 455-462.
38. O'Reilly, Randall C. & Munakata, Yuko (2000). *Computational Explorations in Cognitive Neuroscience: Understanding the Mind by Simulating the Brain*. Cambridge, MA: MIT Press. ISBN 0-262-65054-1.
39. Palmer, Stephen E. (1999). *Vision Science: Photons to Phenomenology*. Cambridge, MA: MIT Press. ISBN 0-262-16183-4.
40. Posner, Michael I. (Ed.) (1989). *Foundations of Cognitive Science*. Cambridge, MA: MIT Press. ISBN 0-262-66086-5.
41. Russell, Bertrand (1946). *History of Western Philosophy*. Routledge Classics.
42. Russell, Stuart & Norvig, Peter (2009). *Artificial Intelligence: A Modern Approach* (3rd Ed.). Upper Saddle River, NJ: Prentice Hall. ISBN 0136042597.
43. Smolensky, Paul & Legendre, Géraldine (2006). *The harmonic mind: From neural computation to optimality-theoretic grammar*. Cambridge, MA: MIT Press. ISBN 0-262-19526-7. [Warning: Very technical, but some chapters are more accessible.]
44. Stillings, N. A., Weisler, S. E., Chase, C. H., Feinstein, M. H., Garfield, J. L., & Rissland, E. L. (1995). *Cognitive Science: An introduction* (2nd Ed.). Cambridge, MA: MIT Press. ISBN 0-262-19353-1.
45. *Topics in Cognitive Science*, vol. 2, no 3, July 2010. [Special journal issue on the 30th Anniversary of the first cognitive science conference in San Diego, 1979.]
http://cognitivesciencesociety.org/journal_topics.html
46. Whitney, Paul (1998). *The Psychology of Language*. Boston, MA: Houghton Mifflin Co. ISBN 0-395-75750-9.
47. Woolsey, T. A., Hanaway, J. & Gado, M. H. (2003). *The brain atlas: A visual guide to the human central nervous system* (2nd Ed.). Wiley. ISBN 0-471-43058-7.

Finally, welcome to the course. I hope that you will enjoy the class and learn valuable information and skills. I look forward to seeing you on January 4.

Alex Petrov