Psych 5612
Introduction to Cognitive Science

Course Syllabus, Fall 2012, Undergraduate version

Course: Psych 5612 (cross-listed as CSE 5531, Ling 5612, and Philos 5830)
Call number: 12411 (graduate) and 12412 (undergraduate)
Credits: 3
Times: Tuesdays and Thursdays 09:35–10:55 a.m.
Room: Cunz Hall, Room 180
Prerequisites: Graduate standing, permission of instructor, or at least 12 credit hours from any of the following areas: computer science, linguistics, neuroscience, philosophy, and psychology.

Websites: https://carmen.osu.edu and http://alexpetrov.com/teach/cogintro/


Instructor: Dr. Alexander Petrov
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200B Lazenby Hall Office hours: T, R 11:00–11:30

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.

All students must be officially enrolled in the course by the end of the second full week of the semester. No requests to add the course will be approved by the Chair after that time. Enrolling officially and on time is solely the responsibility of the student.

**Course Objectives**

Upon successful completion of the course, the undergraduate 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.

The graduate students will:

- Do everything in the above list with proficiency greater than that expected of undergraduate students.
- 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/](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/](https://carmen.osu.edu/)
Evaluation

At the undergraduate level, your grade will depend on the following components:

- Attendance (20 checks worth 2 points each) 40
- Midterm Exam #1 (Thursday 9/27, 9:30 am, Cunz 180) 90
- Midterm Exam #2 (Tuesday 10/30, 9:30 am, Cunz 180) 90
- Final Exam (Friday 12/7, 10:00 am, Cunz 180) 120

Grades are based on absolute cutoffs: A=280-340, B=250-279, C=220-249, D=190-219, E<=189 points, respectively.

At the graduate level, your grade will depend on written homework assignments and on a final paper. See the graduate-level syllabus for details. Graduate students do not need to take the multiple-choice tests. They have in-class discussions on these dates.

Exams: The two Midterm Exams (9/27 and 10/30) and the Final Exam (12/7) are closed-book and consist of multiple-choice questions. Sample questions will be given in class. The Course Calendar section below lists the readings required for each exam. The exams are not cumulative, except that the topics covered in later periods of the course depend on concepts and facts introduced in the earlier periods. No make-up exams will be given, except in the case of documented illness or emergency. 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.

Attendance: Attendance is required, especially on test dates. Come to class – it makes a difference. On top of that, there is a palpable incentive for attending: you earn points by just being present during a roll call. Twenty roll calls will be made during the semester without advance notice. Each time you are present during a roll call you earn 2 points.

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 is 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. It is the responsibility of this Committee to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all
instances of alleged academic misconduct to the Committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct at the above link.

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.

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 students 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, 1760 Neil Avenue, 614-292-3307, TDD 292-0901), please contact Dr. Petrov privately (petrov.11@osu.edu, 200B Lazenby Hall, 614-247-2734) by the end of the second week of classes (9/7/2012) so that any accommodations can be made.

Course Calendar


11. **R 9/27 – Midterm Exam #1** (undergrads only; grad students have a discussion). Material covered in the exam: Lectures 1-10 inclusive. Textbook Chapters 1 and 6 in their entirety, as well as Sections 2.1, 4.1, 7.1, and 7.3. Bechtel (1998, Chapter 5 only); Whitney (1998); Haugeland (1997 and 1985); the Wikipedia entries on logic listed in the PowerPoint slides from Lecture 6.

12. **T 10/02 – Neuroanatomy:** Brain anatomy. Hierarchical functional organization. Decorticate animals. Functional magnetic resonance imaging (fMRI). Readings: Baars & Gage (2010, Ch. 5), Textbook Chapters 3 and 11 and Sect. 4.5.


17. **R 10/18 – Biological Basis of Learning.** Cajal’s synaptic plasticity hypothesis. Long-term potentiation (LTP) and depotentiation (LTD). NMDA receptors and their role in LTP. Synaptic consolidation. Vertical integration. [Optional: Role of LTP/LTD in memory]
Reading: Baars & Gage (2010, Chapter 3). Textbook Sections 4.2 & 4.3.


20. **T 10/30 – Midterm Exam #2** (undergrads only; grad students have a discussion). Material covered in the exam: Lectures 12-19 inclusive. Textbook Chapters 3, 8, and 11 in their entirety, as well as Sections 2.3, 4.2, 4.3, 4.5, and 5.2. Baars & Gage (2010, Chapters 3 and 5); McClelland, Rumelhart, & Hinton (1986);[http://www.inference.phy.cam.ac.uk/mackay/itprnn/1997/l1/node1.html](http://www.inference.phy.cam.ac.uk/mackay/itprnn/1997/l1/node1.html) (nodes 1-7 only – see the address line in your web browser); the Nengo demo videos linked on Carmen (and also available at [http://www.nengo.ca/videos](http://www.nengo.ca/videos)).


    **R 11/22 – Thanksgiving** – no classes


30. **F 12/07, 10:00-11:20 am – Final Exam – Note the unusual day and time!!!**

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.


**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.


17. Eliasmith, C., Stewart, T. C., Choo, X., Bekolay, T., DeWolf, T., Tang, C., & Rasmussen, D. (2012). A large-scale model of the functioning brain. *Science, 338* (30 Nov), 1202-1205. [Cutting-edge article in the most prestigious scientific journal. Announces the SPAUN model, which is discussed briefly in our last lecture. PDF of the main text plus the extensive supplementary material is available on Carmen. An easy to read editorial perspective on this article is also posted on Carmen: Machens, C. K. (2012). Building the human brain. *Science, 338*, 1156-57.]


22. Newell, Allen & Simon, Herbert A. (1976). Computer science as empirical inquiry: Symbols and search. *Communications of the Association for Computing Machinery, 19*, 113-126. [This was the tenth Turing Award Lecture, delivered to the annual conference of the ACM in 1975. Also available from various collections, including Luger (1995, pp. 91-119) and Haugeland (1997, pp. 81-110).]


Recommended Books

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


25. 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.]


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 August 23.

Alex Petrov