Psych 5612

Introduction to Cognitive Science

Course Syllabus, Fall 2012, Graduate 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](https://carmen.osu.edu) and [http://alexpetrov.com/teach/cogintro/](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/. 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/
Four “target articles” from the Additional Readings are particularly important because you are asked to write “reaction papers” about them. These are:
1. Turing’s (1950) seminal paper on the Turing test,
2. McClelland et al. (1986) influential chapter on the appeal of PDP,
3. Anderson & Lebiere’s (2003) proposal of a “Newell test” for a theory of cognition, and
4. O’Reilly et al. (in press) description of the Leabra architecture.

These four target articles will be covered in the lectures. For graduate students only, these same four articles will also be discussed on the two dates on which the undergrads will have Midterm Exams. The discussions will take place in room 219 of the Psychology Building on 9/27 and 10/30 during the regular class hours (9:35-10:55 am). Attendance of these discussions is mandatory.

**Evaluation**

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

- Attendance (20 checks worth 2 points each) 40
- Four reaction papers (one per target article, worth 25 points each) 100
- Term paper (due on the date of the Final, 12/7) 200

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

Graduate students do not need to take any multiple-choice tests. These are for undergraduates. At the graduate level, the grade is based on four written homework assignments, two classroom discussions, and a term paper.

**Reaction papers and term paper:** Each reaction paper must be 600–1000 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 term paper must be at least 2000 words long. There is no upper limit, but please be reasonable. The reaction-paper format is flexible. Feel free to use whatever seems most suitable for your reaction to the target article in question. Possible formats are: a critical review of the article, a reasoned opinion on the article (particularly if you can add another objection, test criterion, etc.), application of ideas in the article to some other topic covered in class, integration of the target article with other readings. You are welcome (and encouraged) to relate the target articles to other things you know but please do not send me the literature review sections of your first-year paper, dissertation proposal, and other such documents only remotely relevant to the target article itself.

Each of the four reaction papers must submitted in electronic form on the Carmen website (https://carmen.osu.edu/). There are five Dropboxes. Your papers must be uploaded to the corresponding Dropbox in MS Word (.docx or .doc), plain text (.txt), PDF, HTML, or RTF format. Papers 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 a paper 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 reaction paper. 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 or lecture – is for the final version of the same reaction 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 reaction 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. The term paper must be submitted in the “Term Paper Dropbox” on Carmen by 11:59 pm on Friday 12/7. Late penalty 50 points per day.

**Attendance and participation in discussions:** Attendance is required, especially on the two discussion 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](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


Haugeland (1985), Textbook Sections 1.2 and 6.3. [Graduate-student discussion of Turing (1950) on 9/27.]


11. **R 9/27 – Discussion #1:** Psychology Bldg, room 219 (grad students only). This discussion covers the two test-related target articles: Turing (1950) and Anderson & Lebiere (2003). The preliminary drafts of your reaction paper to each of these two articles must be uploaded on Carmen by 9:00 am on 9/27.

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. The final draft of your reaction paper on Turing (1950) must be uploaded on Carmen by 11:59 pm on 10/03.


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. Readings: Baars & Gage (2010, Chapter 3). Textbook Sections 4.2 & 4.3.


20. **T 10/30 – Discussion #2:** Psychology Bldg, room 219 (grad students only). This discussion covers the two target articles related to neural networks: McClelland, Rumelhart, & Hinton (1986) and O’Reilly, Hazy & Herd (in press). The preliminary drafts of your reaction paper to each of these two articles must be uploaded on Carmen by 9:00 am on 10/30.


R 11/22 – Thanksgiving – no classes


30. **F 12/07, 11:59 pm – Term Paper must be submitted on Carmen**

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