

CMPE 489 Special Topics: Cognitive Science SYLLABUS

Course Description:

CMPE 489 Special Topics: Cognitive Science (Bilişsel Bilim) (3+0+0) 3 AKTS 6

Introduction of basic concepts, approaches and issues in the field of cognitive science to increase the awareness of the students to the questions raised in the disciplines of computer science, linguistics, philosophy and psychology; focus on the interaction of these disciplines in approaching the study of the mind; specialization on topics central to cognitive science such as the nature of mental representation, reasoning, perception, language use, learning as well as other cognitive processes of humans and other intelligent systems.

Syllabus:

The course will have no main textbook, but roughly the following topics and readings week by week:

Week 1: Introduction to Cognitive Science

Introduction to the study of cognitive sciences. A brief history of cognitive science. Methodological concerns in philosophy, artificial intelligence and psychology.

- Gardner, The Mind's New Science, chapters 2,3,4. Gardner, Howard E. The mind's new science: A history of the cognitive revolution. Basic books, 2008.
- One Hundred Year Study on Artificial Intelligence (AI100), Stanford University, accessed August 1, 2016
- "ARTIFICIAL INTELLIGENCE AND LIFE IN 2030" <https://ai100.stanford.edu/2016-report>
- Kihlstrom and Park, "Cognitive Psychology, Overview", Encyclopedia of the Human Brain, 2002 (optional)
- Nilsson, The Quest for Artificial Intelligence. (optional)

Week 2: Psychology, Nervous system and brain

Structure and constituents of the brain; Brief history of neuroscience; Mathematical models; Looking at brain signals

- Chapter 1 and section 2.3, Bermúdez, José Luis. Cognitive science: An introduction to the science of the mind. Cambridge University Press, 2014.
- Chapters 1 and 2 of Hilgard, Ernest Ropiequet, Richard C. Atkinson, and Rita L. Atkinson. Introduction to psychology. Oxford and IBH Publishing, 1975.
- Gazzaniga, Michael S. "Organization of the human brain." Science 245.4921 (1989): 947-952. (optional)
- Atkinson et al., Intro. To Psychology, chap 2 (optional)
- O'Shea, The Brain: A very short introduction, chap 2,3 (optional)
- Sajda, Neural Networks (optional)

Week 3: Brain and sensorymotor information:

Processing of sensory information in the brain;

- McCulloch, Warren S., and Walter Pitts. "A logical calculus of the ideas immanent in nervous activity." *The bulletin of mathematical biophysics* 5.4 (1943): 115-133.(optional)
- Lecture notes for McCulloch-Pitts and Rosenblatt Neural Networks:
<http://ecee.colorado.edu/~ecen4831/lectures/NNNet2.html>
- "Neural Networks" chapter of "Encyclopedia of the Human Brain" by Paul Sajda (optional)
- "Neuroimaging" chapter of "Encyclopedia of the Human Brain" by Ganis and Kosslyn (optional)
- O'Shea, *The Brain: A very short introduction*, chap 5 (optional)
- Stein et al., *Multisensory integration* (optional)

Week 4: Representation of sensory information:

Neural Network Models; Processing of sensory information in the brain; motor and sensory areas; Brain Imaging, fMRI, MEG, PET, EEG,

- Imaging: *Brain Mapping Methods*, JOHN C. MAZZIOTTA, RICHARD S. J. FRACKOWIAK
- Representation of sensory information: Neural Network Models; Processing of sensory information in the brain; motor and sensory areas;

Week 5: From Sensation to Cognition; Roots of Cognitive Science:

Multisensory integration in cortex; information fusion; from sensation to cognition, cybernetics; From physics to meaning; Analog vs. Digital: Code duality

- Dupuy, *On the origins of cognitive science*, chapters 1,2
- Jesper Hoffmeyer (2002): "Code Duality Revisited", *SEED* 2(1), pp. 1-19.
- Stein, B. E., Meredith, M. A., Huneycutt, W. S., & McDade, L. (1989). Behavioral indices of multisensory integration: orientation to visual cues is affected by auditory stimuli. *Journal of Cognitive Neuroscience*, 1(1), 12-24.
- Wallace, Mark T., and Barry E. Stein. "Sensory organization of the superior colliculus in cat and monkey." *Progress in brain research* 112 (1996): 301-311.
- Jesper Hoffmeyer (2002): "Code Duality Revisited", *SEED (Semiotics, Evolution, Energy, and Development)* 2 (1), pp. 1-19. (optional)

Week 6: Language

What is language?; Linguistic knowledge: Syntax, semantics, (and pragmatics); Generative linguistics; Brain and language; Language disorders; Lateralization; The great past tense debate

- Fromkin, Rodman, and Hyams. *An Introduction to Language*, Boston, MA: Thomson Wadsworth, 9th edition, 2011, chapters 1-2.
- *Introduction to Psychology*, Chapter 2, Asymmetries in the brain
- For details of aphasia categories: "Language and the Brain",
<https://web.stanford.edu/~zwicky/language-and-the-brain-ch4-8.pdf>
- Caplan, *Neural Basis of Language* (optinal)

- Elman et al. Rethinking Innateness, chap 3
- Bermudez, Chapter 1, 1.3: Linguistics and the formal analysis of language
- An Introduction to Language, Chapters 1-2

Week 7: Embodiment

Cognitivist and emergent standpoints ; A robotic perspective

- Ziemke, What's that Thing Called Embodiment? 2003
- Calvo & Gomila, "Handbook of cognitive science", 2008

Week 8: Affordances in biological and artificial systems

Affordances, direct perception, Ecological Psychology, affordance learning in robotics

- Sahin, E., Cakmak, M., Dogar, M. R., Ugur, E., and Ucoluk, G. (2007). To afford or not to afford: A new formalization of affordances toward affordance-based robot control. *Adaptive Behavior*, 15(4), 447-472.
- Jamone, L., Ugur, E., Cangelosi, A., Fadiga, L., Bernardino, A., Piater, J. and Santos-Victor, J., 2016. Affordances in psychology, neuroscience and robotics: a survey. *IEEE Transactions on Cognitive and Developmental Systems*.

Week 9: Cognitive Development

Development, child and robotic development

- Introduction to Psychology, Chapter 3, pg. 68-86.

Week 10: Attention

Attention and related concepts; Human visual attention; Computational models of attention; Applications of computational models of attentional

- Vecera & Luck, Attention, *Encyclopedia of the Human Brain*, Pages 269-284,
- Knudsen, Fundamental concepts of attention, *Annual Review of Neuroscience*, 2007. 30:57-78
- Itti, Koch, "Computational Modeling of Visual Attention" *Nature Reviews Neuroscience*, 2001.

Week 9: Learning

Categories and concepts; Concept learning; Logic ; Machine learning

- Hierarchies in concept attainment. U Neisser, P Weene - *Journal of Experimental Psychology*, 1962
- E. Alpaydm, Intro. to Machine Learning, Chapter 1&2

Week 10: Memory

Constructing memories; Explicit vs. implicit memory; Information processing (three-boxes) model of memory; Sensory memory; Short term memory; Long term memory

- Atkinson&Hilgard's *Introduction to Psychology*, Chapter 8, Memory

- Miller, George A. "The magical number seven, plus or minus two: some limits on our capacity for processing information." *Psychological review* 63.2 (1956): 81.

Week 11: Reasoning

Rationality; Bounded rationality; Prospect theory ; Heuristics and biases; Reasoning in computers

- Atkinson et al., *Intro. To Psychology*, chapter 9
- Hertwig & Todd, *Heuristics* (optional)
- Simon, *Bounded Rationality in Social Science: Today and Tomorrow*, *Mind & Society*, 1, 2000, 25-39.(optinal)

Week 12: Social Cognition

Key points in social cognition; Context and social judgment; Schemas; Social signals

- Kasslin, chap 11: *Social and Cultural Influences*
- Week 13 & 14: Project presentations