CMPE 489/COGS 500: Intro. to Cognitive Science

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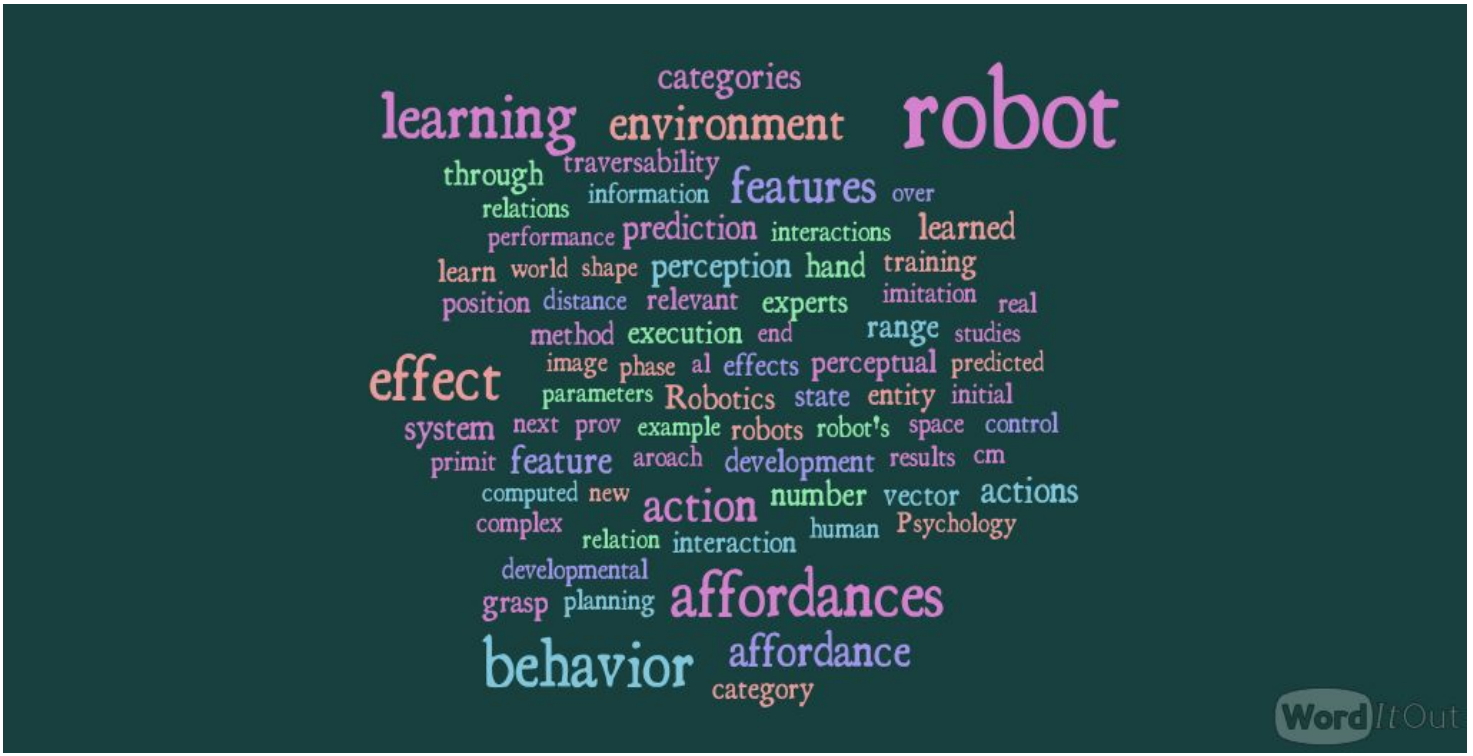
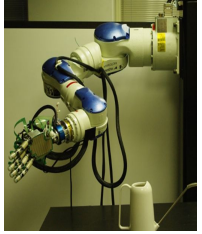
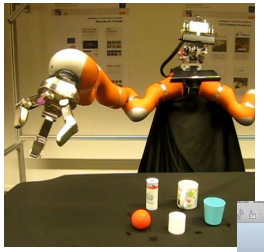
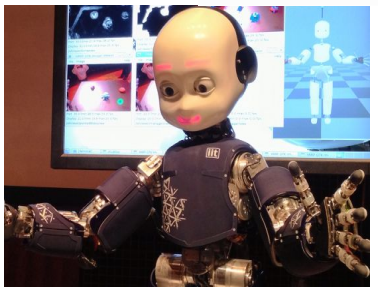
Slides adapted from
Albert Ali Salah

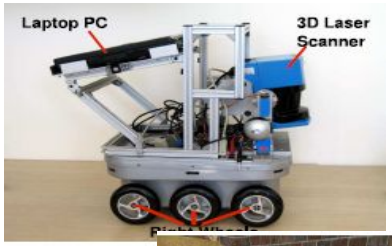








CoLoRs Lab: Cognition, Learning and Robotics



Basic information

- Time & Place:
  - Monday 13:00-14:00 – BM A3
  - Tuesday 09:00-11:00 – BM A3
- Staff:
  - Instructor: Emre Ugur
    - E-mail: emre.ugur@boun.edu.tr
    - Office: BM33
    - Office hours: Fridays 9:00-10:00
  - Teaching Assistant: safa.andac@boun.edu.tr
- Mailing list: cogs500-cmpe489@listeci.cmpe.boun.edu.tr

Basic information

- Format:
  - In-class discussions, no ‘main’ textbook
  - Quiz in a random time
  - Assignments every week
  - A lot of readings

- Grading:
  - Quizzes: 10
  - 10 homeworks: 30
  - midterm: 20
  - final: 20
  - project: 20

Basic information

- Course materials:
  - Will be (mostly) available in the library?
  - Will be available in course webpage:

https://www.cmpe.boun.edu.tr/~emre/courses/cogs500-cmpe489/

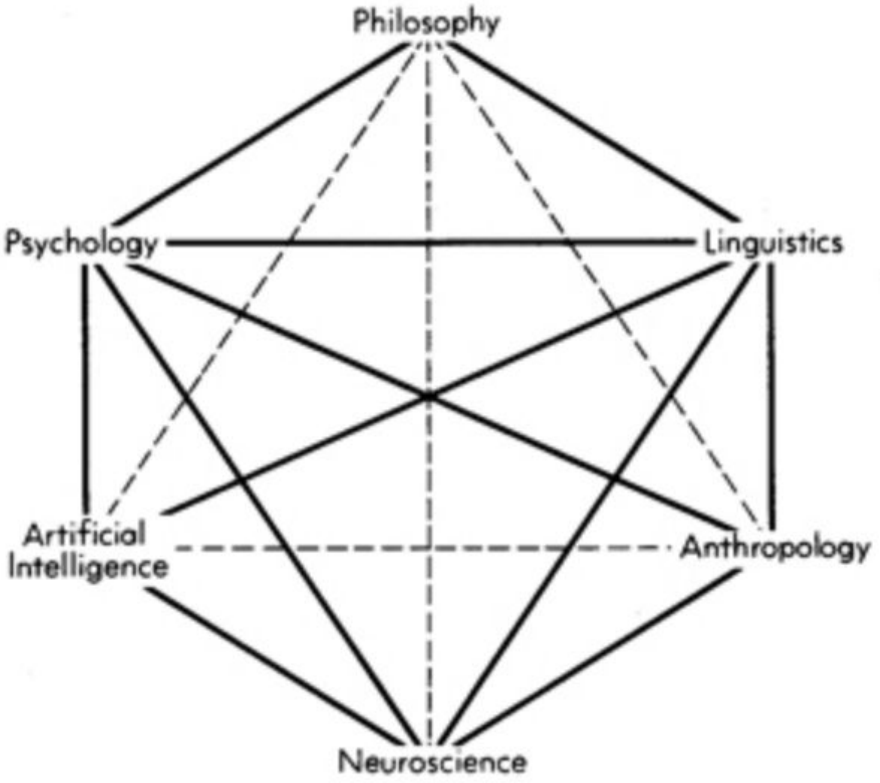
- cogs500-cmpe489@listeci.cmpe.boun.edu.tr

What is cognitive science?

- “The science of the mind” Bermudez
- Cognitive: «perceiving and knowing»
- What does it involve?

- “a contemporary, empirically based effort to answer long-standing epistemological questions – particularly those concerned with the nature of knowledge, its components, its sources, its development and its deployment” Gardner

Scope of cognitive science



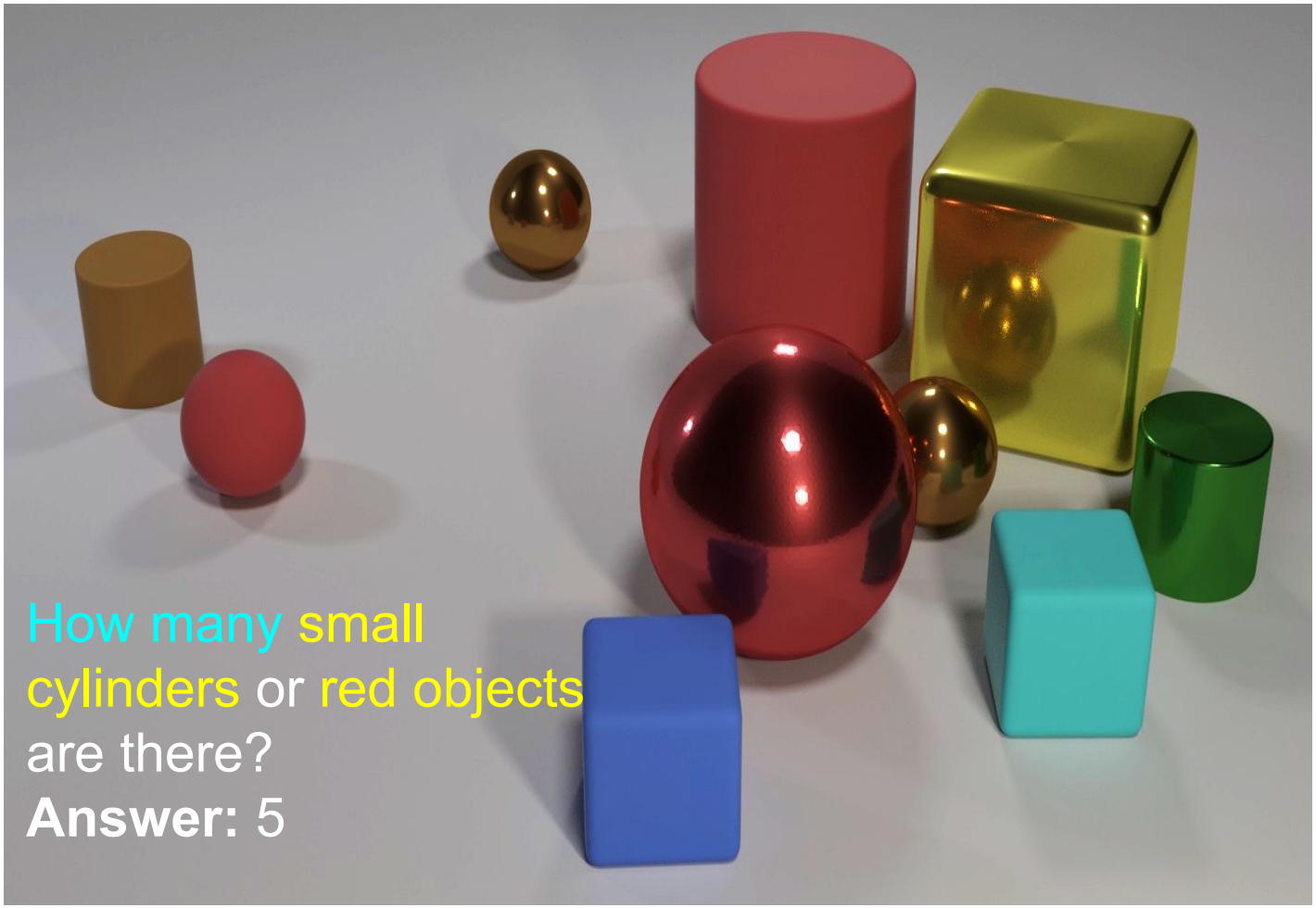
Connections among the Cognitive Sciences

KEY: Unbroken lines = strong interdisciplinary ties
Broken lines = weak interdisciplinary ties

Sloan Initiative
SOAP unpublished report, 1978

Scope of cognitive science

State-of-the-art language and scene understanding



*adapted from Dr. Aykut Erdem

Syllabus, course syllabus pdf

Guest lecturers:

- Prof. Cem Say
- Dr. Inci Ayhan
- Dr. Lucas Thorpe
- Prof. Yagmur Denizhan
- Dr. Gunes Unal
- Prof. Mina Nakipoglu
- Dr. Gunes Unal
- Dr. Pavel LOGAČEV

++ talks by msc/phd students

Turing Machine: The idea of algorithm and computation

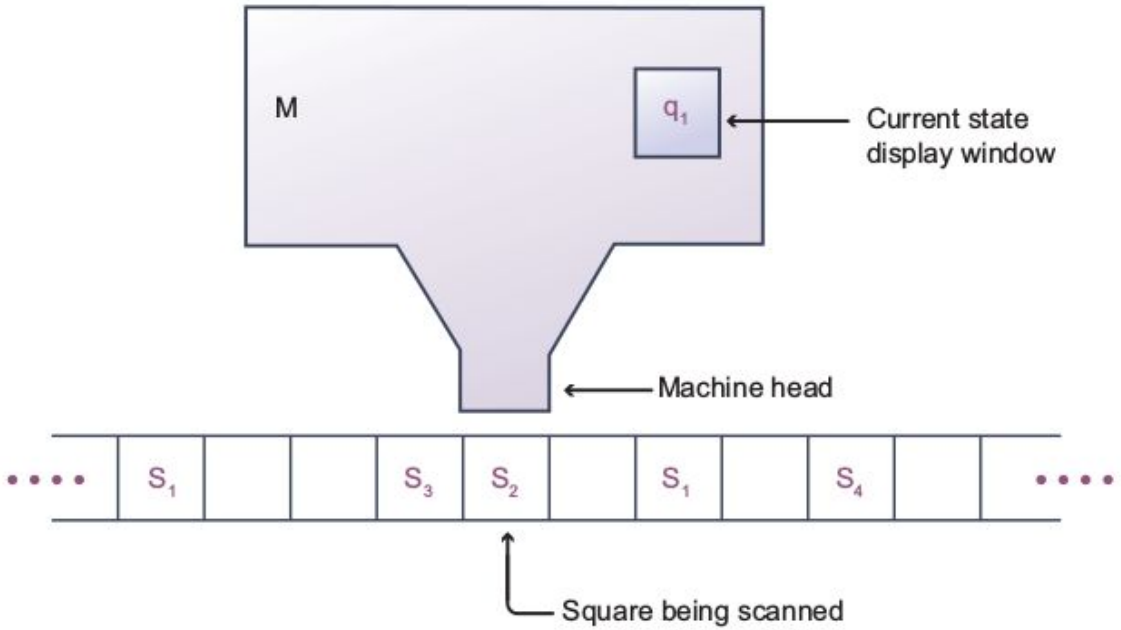


Figure 1.4 Schematic representation of a Turing machine. (Adapted from Cutland 1980)

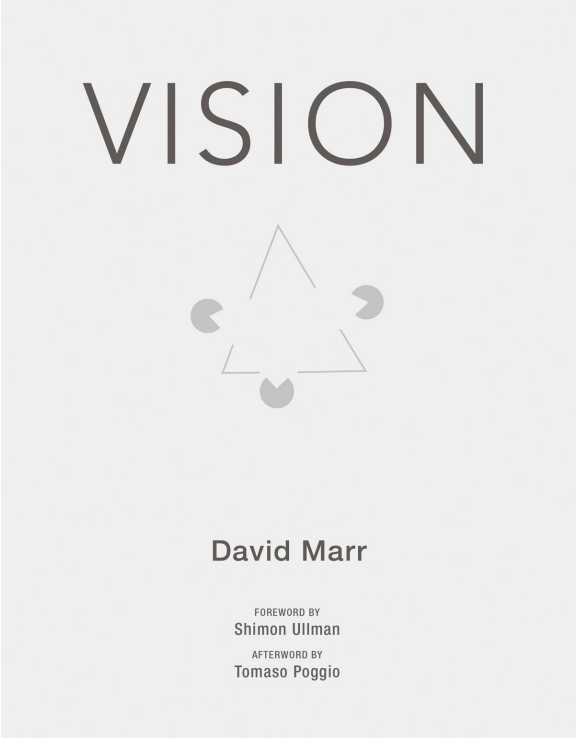
- delete the symbol in the cell
- write a new symbol in the cell
- move the tape one cell to the left
- move the tape one cell to the right

Cognitive Science in 1950's

- Turing, Alan M. "On computable numbers, with an application to the Entscheidungsproblem." Proceedings of the London mathematical society 2.1 (**1937**): 230-265.
- McCulloch, W. S., & Pitts, W. (**1943**). A logical calculus of the ideas immanent in nervous activity. The bulletin of mathematical biophysics, 5(4), 115-133.
- Lettvin, J. Y., Maturana, H. R., McCulloch, W. S., & Pitts, W. H. (**1959**). What the frog's eye tells the frog's brain. Proceedings of the IRE, 47(11), 1940-1951.
- Hubel, David H., and Torsten N. Wiesel. "Receptive fields of single neurones in the cat's striate cortex." The Journal of physiology 148.3 (**1959**): 574-591.
- Miller, G. A. (**1956**). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological review, 63(2), 81.
- Newell, Allen, and Herbert Simon. "The logic theory machine--A complex information processing system." IRE Transactions on information theory 2.3 (**1956**): 61-79.
- Chomsky, Noam. "Three models for the description of language." IRE Transactions on information theory 2.3 (**1956**): 113-124.
- Von Neumann, John. **1958** The computer and the brain. Yale University Press,.
- Putnam, H. **1960**. "Minds and Machines." InS. Hook, ed., Dimensions of Mind. New York: New York University Press.
- Marr, D. (**1982**) Vision: A Computational Investigation info the Human Representation and Processing of Visual Information. San Francisco: W. H. Freeman.

Model of vision

- Mind can be studied in different levels:
  - Bottom-up
  - Top-down
- Earliest systematic approach: David Marr's model of human visual system (1982)
- Integrated results from psychology, artificial intelligence, and neurophysiology into new models of visual processing.
- His work was very influential in computational neuroscience



Three levels of description *(David Marr, 1982)*

Computational

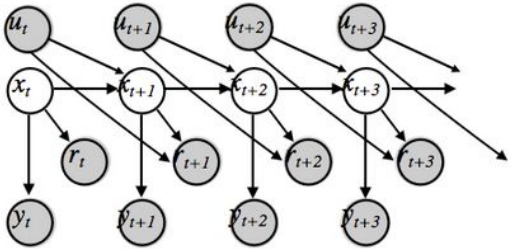
Why do things work the way they do?
What is the goal of the computation?
What are the unifying principles?

maximize:

$$R_t = r_{t+1} + r_{t+2} + \cdots + r_T$$

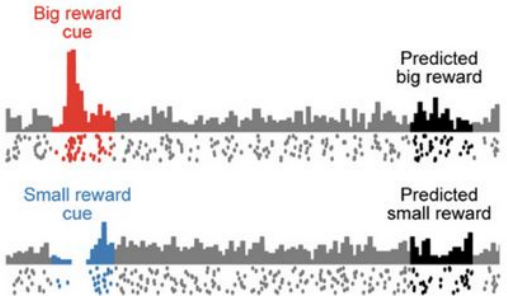
Algorthmic

What representations can implement such computations?
How does the choice of representations determine the algorithm?



Implementational

How can such a system be built in hardware?
How can neurons carry out the computations?



https://fias.uni-frankfurt.de/~rothkopf/docs/david_marr_3_levels.jpg

Turing machine example

- Computational
  - Characterization of multiplication function
- Algorithmic
  - Turing machine table
- Implementational
  - Construction of a physical Turing machine

Visual perception model of Marr

- Computational
  - Derive a representation of the 3-d shape and spatial arrangement of an object in a form that allow that object to be recognized.
  - Object centric view.
- Algorithmic
  - How exactly input/output encoded. Representational primitives, what sort of operations on those primitives
  - Intensity of light reaching retina,
- Implementation level

  Actual implementation