COGS 105

Research Methods for Cognitive Scientists

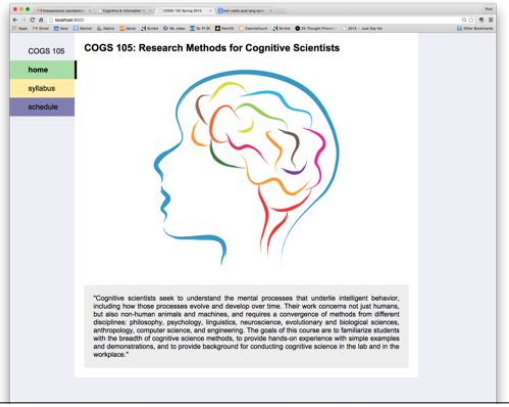
Week 1, Class 1:
Introduction to the Course; Preliminaries

Cognitive Science

- Cognitive science is the **scientific study of intelligent behavior** – its processes, development, and evolution.
- Intelligent behavior involves a lot **more than just stuff going on "inside your cranium."**
  - Social and cultural and environmental influences; emotional and bodily influences
  - Growing consensus: Your mind/brain is part of a broader system that involves your body and the world.
- **Ongoing mystery**: Figuring out how it all fits together.

Important: Course Site

cognaction.org/cogs105



Who Are You People?

Class time and location. Tuesdays and Thursdays, 6-7:15pm, COB 116

Teaching team.

Prof. Rick Dale, rdale@ucmerced.edu, instructor
Office hours: Tuesdays and Thursdays from 5-6pm, SSM 261A

Bryan Kerster, bkerster@ucmerced.edu, teaching assistant, Ph.D. student
Section: Tuesdays, 7:30-8:20pm [06L] and 8:30pm-9:20pm [07L], SSM 154
Consult Bryan in section for his office hours

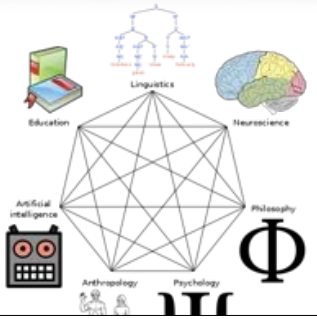
Alexandra Paxton, aloan@ucmerced.edu, teaching assistant, Ph.D. student
Section: Mondays, 7:30-8:20pm [02L] and 8:30pm-9:20pm [03L], SSM 154
Consult Alex in section for her office hours

Janelle Szary, jszary@ucmerced.edu, teaching assistant, Ph.D. student
Section: Wednesdays, 7:30-8:20pm [04L] and 8:30pm-9:20pm [05L], SSM 154
Consult Janelle in section for her office hours

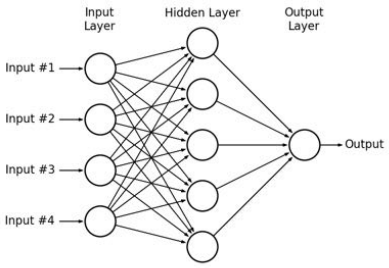
Overview. Cognitive scientists seek to understand the mental processes that underlie
including how those processes evolve and develop over time. Their work concerns r

Outline of Course

Overview. Cognitive scientists seek to understand the mental processes that underlie intelligent behavior, including how those processes evolve and develop over time. Their work concerns not just humans, but also non-human animals and machines, and requires a convergence of methods from different disciplines: philosophy, psychology, linguistics, neuroscience, evolutionary and biological sciences, anthropology, computer science, and engineering. The goals of this course are to familiarize students with the breadth of cognitive science methods, to provide hands-on experience with simple examples and demonstrations, and to provide background for conducting cognitive science in the lab and in the workplace.



Learning Outcomes



Learning Outcomes. By the end of the co
methods in cognitive science. They will deve
the ability to understand and think critically
hands-on experience with a variety of cogniti

Behavioral experiments: Measure human
psychological methods. Students will work

Cognitive neuroscience experiments: An
neuroscientific methods. Students will extr

Observational methods: Students will care
to the development of research questions
facts of languages as evidence of how m
corpora.

Computational models: Design and imp
processes and properties, which is centra
will work with one or two simple examples

Robotics & artificial life: Design and imple
cognition or behavior, which is central to
simple examples.

Readings. There is no textbook for this co

Readings

simple examples.

Readings. There is no textbook for this course. Ma
this website. Regular readings will be assigned relat

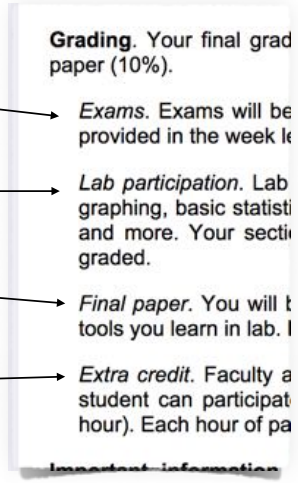
Grading

exams
20% x 3 = 60%

labs
30%

final paper
10%

Up to bonus 5%!


Grading. Your final grad
paper (10%).

Exams. Exams will be
provided in the week l

Lab participation. Lab
graphing, basic statisti
and more. Your secti
graded.

Final paper. You will b
tools you learn in lab. I

Extra credit. Faculty a
student can participat
hour). Each hour of pa

Lecture Slides

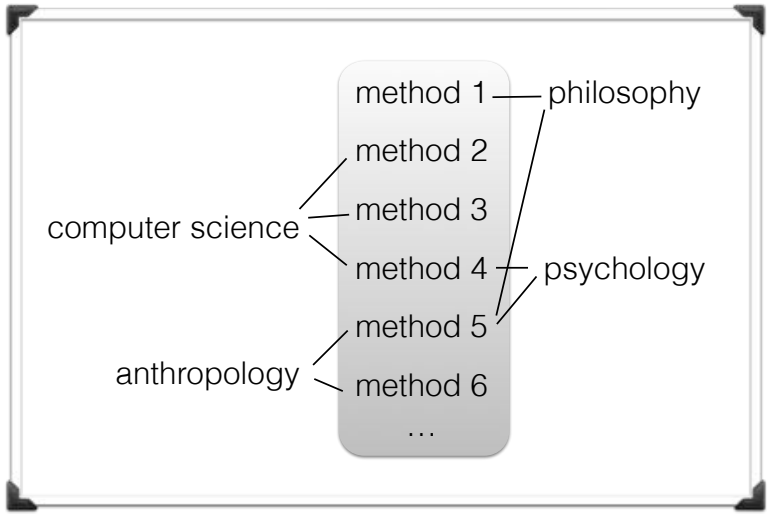
- Yes, a simplified version of the lecture slides will be provided each week.
- Study guides will be supplied 1 week prior to exams.

No Section This Week

- Note, there will be **no sections this week**; we start next week.
- Monday was a holiday; no material to discuss.

Let's Start

the big questions frame the scientific value of our methods



What Thinks?

Complex Dog Cognition?

- Chaser the border collie can respond uniquely to over 1,000 English words.

Big Questions

- Big concepts and questions: What is **thinking**? What is **intelligence**? What is **consciousness**?
- If we assume something does think, *how can we find out what kind of thinking it does?*
  - **All kinds**: Perception, action, problem solving, language, memory, learning, etc.
- Cognitive science is hopeless without **rigorous methodologies**, especially empirical and computational methodology.

Multi-Methodological…

- Philosophy
- Psychology
- Anthropology
- Neuroscience
- Biologist
- Linguist
- Mathematician
- Computational scientist
- Artificial Intelligence

Philosophy Approach

- Many important questions about thinking cannot be addressed experimentally, so use logic and reason to address them.
  - Is it possible for non-biological systems (e.g., computers) to have thoughts?
  - What is the connection between the mental and physical?
  - Is there free will?
  - Consciousness???

Dr. Carolyn Jennings, UCM Philosopher and Cognitive Scientist

Psychological Approach

- Thinking is expressed through behavior, so experiment with behavior to infer what is going on in thinking.
  - Reflexes? Tapping?
  - Simple and choice responding
  - Categorizing
  - Talking, reading
  - Planning, readoning, gaming, etc.
  - Music? Art? Dating? Emotion?

Dr. Eric Walle
UC Merced Psychologist

Anthropological Approach

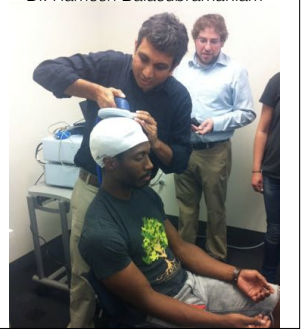
- Thinking occurs naturally in social and cultural contexts, so observe behavior *in situ* to infer thinking mechanisms.
  - Compare across cultures, social situations, languages
  - Compare across evolutionary history, in terms of biology as well as culture and society

Dr. Holley Moyes
UCM Anthropologist

Neuroscience Approach

- Thinking in biological organisms requires neurons, so observe and experiment with the brain to infer thought mechanisms.
  - Molecules and DNA? Ion channels?
  - Spiking patterns across the brain?
  - Brain areas? Networks?

Dr. Ramesh Balasubramaniam



Butovens Médé, Ph.D. student

Biological Approach

- Thinking occurs in all sufficiently complex biological organisms, so use simpler organisms as models of thinking mechanisms.
  - Model organisms can be controlled more easily.
  - How simple can we get?
  - What aspects are general across organisms?
  - Ethical issues.

Dr. Suzanne Sindi
some dude
Dr. David Ardell

interdisciplinary project!

Linguistic Approach

- Thoughts may be symbolic in nature, and language is the quintessential symbolic system, so study language to infer thought mechanisms.
  - Sounds? Words?
  - Grammar? Meaning?
  - Discourse?

Dr. Stephanie Shih
UC Merced Cognitive Scientist and Linguist

Mathematical Approach

- Theories of thinking are most powerful and testable when formalized, so use mathematical expressions from which properties can be derived, proven, tested…

Dr. Roummel Marcia

Dr. Suzanne Sindi

Applied Mathematics UC Merced

Computational Approach

- Theories of thinking can be setup as computer programs, so run those programs to hone, explore, and test theories!
  - Models might be based on ideas from the brain or other areas (such as logic or rule systems; see **Reading 2**)
  - Models are typically very complex

Dr. Anne Warlaumont
UC Merced Cognitive Science, Hardcore Neural Computationalist

Artificial Intelligence

- Thinking is not tied to biological substrates, so let's build machines that implement thinking mechanisms.
  - Can be quite different from cognitive models.
  - How similar are artificial systems to the way humans think?

Dr. Paul Maglio
UC Merced Cognitive Scientist talking to IBM about Watson

Does Watson Think?

- Is Watson intelligent?
- For a primer on these issues, which are now a half-century old, check out the required **Reading 1** + online activity.

Multi-Methodological…

- Philosophy
- Psychology
- Anthropology
- Neuroscience
- Biologist
- Linguist
- Mathematician
- Computational scientist
- Artificial Intelligence

hands on

See you Thursday!

- Remember, **no sections held this week**; let's start next week!
- **Thursday**: Following along our line of discussion about the history and goals of cognitive science.