Cognitive Science 102A
Distributed Cognition
Professor Edwin Hutchins

https://thiscourse.com/ucsd/cogs102a/fa13/

What the course is about
- The BIG questions of Cognitive Science
- How shall we explain or understand processes like thinking, reasoning, speaking, decision making, planning, and so on?
- How did cognitive science get where it is?
- Where can cognitive science go from here?

Cognitive science as a slice of scientific cake

The two key ideas in distributed cognition
- Cognition emerges from interactions among elements at many scales
- We continually ask this question:
  - "What information goes where, when, in what form?"
High-level Cognitive Processes

GOFAI  High-level Cognitive Processes

Nervous System

GOFAI  High-level Cognitive Processes

Low-level processes perceptual/motor

Connectionism Neural Nets

Embodiment A-Life

Plans and the structure of behavior

The material world and the structure of behavior

Low-level processes perceptual/motor

Connectionism Neural Nets

Embodiment A-Life
What is mind?

- What is special about minds (even your cat’s mind) as opposed to inanimate objects?
- And what is special about human minds compared to other animal minds?
- Mindfulness is just matter… nicely orchestrated

Where is the mind?

- Many cognitive scientists say that the mind is in the brain. Or they say that the mind is what the brain does.
- Is this right?
- Is it the best approach?

The mind in the brain

Understanding cognition is largely understanding the *dynamic flow of information* through the system

Our key question

- What information
- goes where
- when
- in what form?
Our key question

- What information?
- Goes where?
- When?
- In what form?

Disembodied Cognition?

Is the mind in the nervous system?

- A brain in a vat is a very poor model of the human cognitive system.
- The brain gets input from and sends output to other parts of the nervous system.

Perhaps we need to add the body to explain the mind

Consider two example situations

**Situation 1:** driving your car while having a conversation
**Situation 2:** reading out aloud while tapping your feet to the rhythm of some music

Same input/output modules, yet different information flow!

From a talk by Jochen Triesch 2003

Do animals with different bodies have different minds?

The mind in the interaction of the body with the world

- The body is in a physical world, and the structure of that world interacts with the body and the nervous system and the brain to shape what we think and how we think.
- The brain is a controller for body-world interaction

Photo: Ron Church, The Surfer's Journal Volume 9, No. 4
Photo: Edwin Hutchins, 2007
Mind in the interaction of the brain and body with a culturally constructed world

- Human life is lived in complex social environments that are filled with cultural artifacts.
- Our cognition and our mindfulness emerge from the interactions of our brains and bodies with this socio-cultural world.

The ingredients of a new kind of scientific investigation of cognition

- **Theory:**
  - Distributed Cognition
- **Method:**
  - Cognitive Ethnography (COGS 102B)
- **Human activity systems:**
  - Ship Navigation (CitW)
  - Science Laboratories
  - Commercial Aviation
  - ... any other activity you can think of

Distributed Cognition

- **Fundamental premise:** Cognition, in all its forms, emerges from the interactions among the elements of complex systems.
- **Cognitive Systems (units of analysis):**
  - a neural circuit composed of interacting neurons
  - an area of the brain (e.g. V1 in visual cortex) composed of interacting neural circuits
  - a whole brain composed of interacting areas (multimodality)
  - a whole brain and a whole body in interaction
  - brain-body-world in interaction

A hypothesis about human cognition

- High-level human cognition depends on interactions with culturally organized material and social structures.
  - **Weak Dcog:** Cognition is affected by or shaped by interactions with the material and social world.
    - Action reveals underlying cognitive processes
  - **Strong Dcog:** Some forms of human cognition are constituted in interactions of brain and body with material and social world.
    - Action is a form of cognition

Checking our progress

- The preferred unit of analysis for distributed cognition:
  - A is the human brain
  - B is the brain-body-world interaction system
  - C is the brain-body-culturally-organized-world interaction system
  - D depends on the question we want to answer
Cognition in the Wild (1995)

An extended case study of distributed cognition
- Examples from ship navigation
- How institutions think
- Where is computation/cognition/mind?
- Embodied cognition in cultural context
- Cognitive properties of groups
- Individual and institutional learning
- The costs of ignoring culture when studying cognition

Mindware (2001)

The development of cognitive science
- Andy Clark’s combination history and critical reflection.
- Mindfulness as (some sort of) computation.
- Recent wrinkles
  - Embodiment
  - Robotics
  - Dynamics
  - Interaction with the material world

Supersizing the Mind (2008)

Andy Clark
Philosopher of Cognitive Science
How to Succeed in this Course

https://thiscourse.com/ucsd/cogs102a/fa13/

The thinking/writing process

- Careful reading
- Additional research
- Note taking
- Drawing diagrams and sketches
- Outlining
- Writing/reflecting/re-writing
- Getting and giving constructive critical advice

Essay writing topics

1. Intro to CPR: Why you chose your major
2. Exploring a decentralized system
3. Features of socially distributed cognition
4. The principle of ecological assembly
5. The cumulative construction of cognitive ecosystems

Calibrated Peer Review

1. Plan, write, and edit your essay
2. Submit your essay to the CPR web site
3. Learn how to use specific criteria to evaluate an essay (practice on three essays)
4. Evaluate the essays written by 3 of your classmates
   • Meanwhile, 3 classmates will be evaluating your essay
5. Apply the evaluation criteria to your own essay

CPR credit elements

<table>
<thead>
<tr>
<th>Scores and Overall Grade</th>
<th>Stage</th>
<th>Performance</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Entry</td>
<td>Avg. Weighted Test Rating = 7.22</td>
<td>21.66 out of 30</td>
<td></td>
</tr>
<tr>
<td>Calibrations</td>
<td>Avg. Calibration Deviation = 0.33</td>
<td>20.92 out of 30</td>
<td></td>
</tr>
<tr>
<td>Reviews</td>
<td>Avg. Review Deviation = 0.95</td>
<td>30.60 out of 30</td>
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<tr>
<td>Self-Assessment</td>
<td>Self-Assessment Deviation = 1.70</td>
<td>10.00 out of 30</td>
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<tr>
<td>Overall Score</td>
<td>81.66 out of 100</td>
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Intro to CPR assignment

- A practice assignment to give you a chance to experience how CPR works
- Why did you choose your major?
<table>
<thead>
<tr>
<th>Evaluation and self-evaluation</th>
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<tbody>
<tr>
<td>Engage the ideas</td>
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<tr>
<td>Stay on topic</td>
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<tr>
<td>Successful expression</td>
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<tr>
<td>Clarity</td>
</tr>
<tr>
<td>Reflection on your own writing/thinking process</td>
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<table>
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<tr>
<th>Do the Readings</th>
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<tbody>
<tr>
<td>Keep up with the reading schedule</td>
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<tr>
<td>Read carefully and critically</td>
</tr>
<tr>
<td>Use the guidance provided on the class website</td>
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<tr>
<td>THINK ABOUT WHAT YOU ARE READING!</td>
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<table>
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<tr>
<th>Get a good Dictionary and use it</th>
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<tbody>
<tr>
<td>Meanings</td>
</tr>
<tr>
<td>Word choice</td>
</tr>
<tr>
<td>Usage conventions</td>
</tr>
<tr>
<td>Spelling</td>
</tr>
<tr>
<td>Language is a social tool. Knowledge is power. Workout and get strong</td>
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<table>
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<tr>
<th>Spend some Time on the Course</th>
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<tr>
<td>The registrar expects you to work 12 hours per week for a 4 unit course!</td>
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Come to Lecture Sessions
- Clean, sober, and awake
- Do NOT sleep in class
- Cell phones OFF!
- Be here. No IM, texting, or web-surfing in class
- If you don’t understand something, ASK for clarification.
- You may take notes if you like. Remember, the lectures will be podcast and the slides will be posted on the course website.

Go to your Discussion Section
- Discuss the readings and lectures
- Clarify issues
- Work on your essays
- Prepare for the midterm and final exam

Do the Assigned Work
- Start ahead of time
- Be sure you understand each assignment
- Make your essays easy to read and understand
- PROOFREAD! Check spelling and grammar
- Turn CPR projects in ON TIME

Visit Office Hours
- We are here to help you
- You (or your parents) are paying for our time
- Explore ideas
- Clarify assignments

Do NOT attempt to CHEAT!
- Do your own work. You are encouraged to talk to other students about ideas, but do not “borrow” material from other students.
- Understand the concepts in the plagiarism tutorial.
- Do NOT look at your neighbor’s paper during the exams.

Be Creative
- Learning can be fun.
- This course is about ideas, not the memorization of facts.
- Ideas never stand alone. They are always related to other ideas. Explore the world of ideas.
Appreciate the Challenge of Cognitive Science

- Many of the central questions in this field are still unanswered.
- The questions in this course relate directly to your daily life in some way. Be alert for connections to your own experience.
- You can do it!

Basis of your Grade

- Plagiarism Tutorial: 2%
- Intro to CPR: 3%
- 4 Written assignments @20 ea.: 80%
- Midterm Exam: 5%
- Final Exam: 10%

Total: 100%

Instructional team

- TAs
  - Tyler Marghetis
  - Robert Gougelet
- IAs
  - Ram Dixit
  - Gunbir Dhillon
  - Kenna Hasson

For Tuesday

- Buy Cognition in the Wild and Supersizing the Mind (Both available at the bookstore and via Amazon on course website)
- Review the material on the course web site.
- In particular, consult reading guidance for Tuesday’s assignment on website
- Do the plagiarism tutorial and quiz
- Sign on to CPR and set up your profile
- Read these two papers (available on the website)
  - Mitch Resnick “Learning about life”
  - Edwin Hutchins, “Cognition, Distributed”

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