Informatics 1 Cognitive Science

Lecture 1: Course Overview

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Overview

What is Cognitive Science?

Course Overview

Course Organization

Preview for next time: Pizza Problems

Starting with a Short Survey

We will do a short survey on WooClap:

1. Which degree are you studying for?
2. Which year are you in?

https://app.wooclap.com/JMXJSF

Your Course Lecturers

Frank Keller

Matthias Hennig

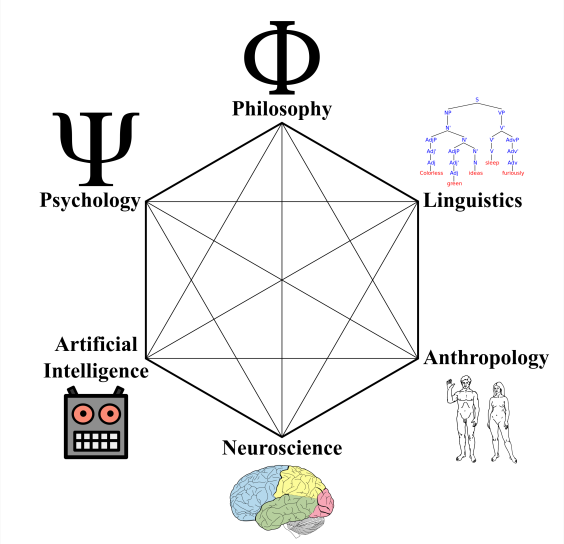
Robyn Greene (TA)

Jordan Watts (TA)

What is Cognitive Science?

What is Cognitive Science?

Cognitive science is the scientific study of the human mind. Highly interdisciplinary:



What is Cognitive Science?

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- A mental representation is a description of information in the mind.
- A mental process is a procedure for translating:
  - sensory information into representations;
  - representations into other representations; and
  - representations into actions/behavior.

What is Cognitive Science?

We will look at the overall landscape of cognitive science:

- what kind of *questions* cognitive scientists ask;
- what type of *data* they collect to answer these questions;
- what *theories* they build based on these data;
- what computational *models* they use to implement these theories.

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Computational modeling can be used to *evaluate theories, generate new hypotheses, guide the collection of new data.*

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Vote on WooClap!

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2. Could we still deal with quantities if we didn't have any numbers?

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What is Cognitive Science?

Let's look at a few examples of questions we might ask about human cognition:

1. Does our brain get physically bigger when we learn something new?
2. Could we still deal with quantities if we didn't have any numbers?
3. Can computers learn anything we can learn?

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   More on neural nets in week 2.

References:

1. Maguire, E. A., Gadian, D. G., Johnsrude, I. S., Good, C. D., Ashburner, J., Frackowiak, R. S., & Frith, C. D. (2000). Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Sciences,* 97(8), 4398–4403.
2. Frank, M. C., Everett, D. L., Fedorenko, E., & Gibson, E. (2008). Number as a cognitive technology: Evidence from Pirahã language and cognition. *Cognition,* 108(3), 819–824.
3. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature,* 521, 436–444.

Continuing with the Short Survey

1. What do you find most exciting about Informatics 1 Cognitive Science?
2. What is your biggest worry about the course?

Provide your answers on WooClap!

Course Overview

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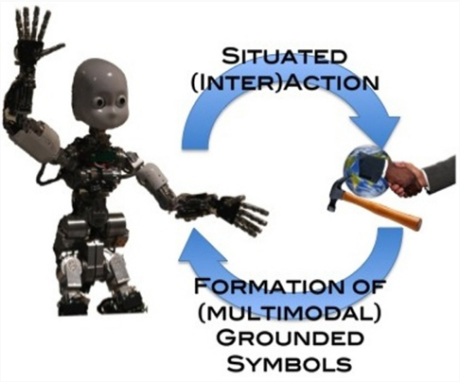
This course provides an introduction to cognitive science from a computational perspective. There are three main parts:

- language, categories and decision making
- memory, vision and neural computation

We will introduce important problems, data, theories in the field (some of this may be familiar from Introduction to Cognitive Science or from Psychology 1A).

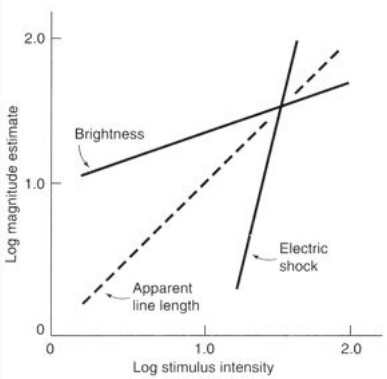
Here the focus will be on the *computational modeling* of these problems, data, theories. You will learn to design, implement, and test cognitive models.

Modeling in Cognitive Science



- People often use "model" and "theory" interchangeably;
- modeling can have physical, mathematical and computational aspects to it;
- in this course, when we talk about models, we mainly mean *computational models.*

Modeling in Cognitive Science



$$P = k\,S^{n}$$

P : perceived magnitude
S : stimulus intensity
k : constant

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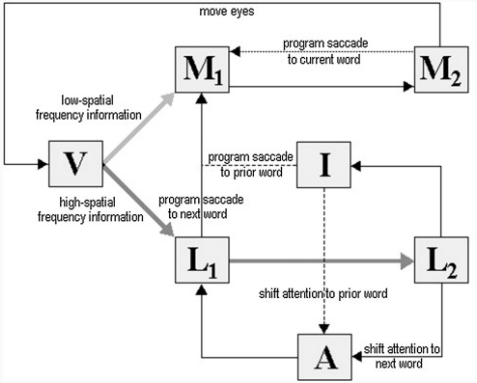

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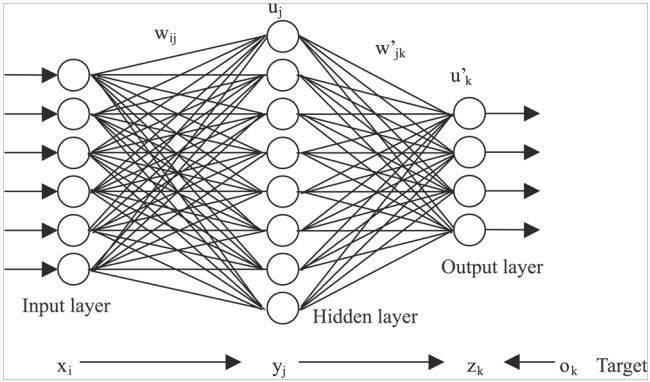

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What this Course Covers

Part 1: Language, Categories, Decision Making (Frank Keller)

- introduction to language
- language acquisition
- neural network models
- word segmentation
- Bayesian modeling
- word learning
- communication efficiency
- vector semantics
- categories
- decision making and biases

What this Course Covers

Part 2: Memory, Vision and Neural Computation (Matthias Hennig)

- brain anatomy and function
- neurons and spikes
- modeling the brain
- recording neural activity
- vision
- learning and memory
- synaptic plasticity
- auto-associative memory
- reinforcement learning

Required Background

This course is suitable of outside students. But bear in mind:

- the assignments require programming in Python;
- Introduction to Cognitive Science provides relevant background; Informatics 1A is also useful;
- there will be some maths (probability, linear algebra, calculus).

The labs are designed to provide help with programming. Other sources of support:

- InfBase: dedicated drop-in sessions for this course; timetable will be published shortly;
- InfPALS: peer-assisted learning scheme for first-year courses.

Continuing with the Short Survey

1. Have you ever used Python before?
2. Do you have experience with another programming language?
3. How comfortable are you with maths?

Provide your answers on WooClap!

Course Organization

Lectures

Three lectures per week:

- All the lectures of this course will be in person. However, they will also be live streamed and recorded. Details on the course website.
- All the material for a given week will be released on the previous Friday. This will include a list of tasks for that week.
- This includes self-study (reading) and preparation for labs and tutorials.

Advice: Try to keep up with the lectures and the weekly course tasks (rather than trying to binge-watch all the videos later . . .).

Tutorials

Tutorials are one-hour small-group sessions led by a tutor:

- they cover the material from the lectures;
- they help you practice and apply this material, allow you to discuss and ask questions;
- tutorials are good as preparation for the exam;
- a question sheet is issued for each week; prepare for the tutorial by working through this sheet;
- tutorials start in *week 2;*
- you will be automatically enrolled for a tutorial group; change your group on MyEd if the day/time is not suitable.

Labs

The labs are two-hour practical sessions:

- labs will help you with programming and prepare you for the assignment;
- the first three labs are designed to get you up to speed with Python; the following labs will provide support for the assignment;
- the labs will use Notable notebooks (in Python); they are linked from the Learn site of the course;
- you work through the notebooks independently during the lab, but a demonstrator is on hand to help;
- labs start in *week 2;*
- the labs are drop-in: you don't need to enroll, just show up to a lab session that's convenient for you.

Assessment

The assessment for this course consists of an assessed assignment, worth 20% of the overall mark, five assessed quizzes, each worth 4% of the overall mark, and a final exam, worth 60% of the overall mark.

The assignment is practical; it requires programming in Python and uses Notable. The labs are there to support the assignment.

There is also an *unassessed assignment* (Assignment 0). It has already been issued, deadline in week 3. You will receive feedback on your submission.

The assessed quizzes are untimed, will be online from Friday to Monday, and should take less than 30 minutes to complete.

Issue dates, hand-in deadlines, and marking deadlines for assignment and quizzes are on the course website.

How We Communicate

The most important sources of information for the course are:

- the Course Website: contains all course materials.
- the Learn page of the course: contains links the Noteable environment for labs and assignment.
- announcements from the lecturers and TAs through the Learn page of the course.

We will use a Piazza forum for the course:

- you can use it to post questions about the course content, including tutorials, labs, and assignment;
- the main purpose is *peer support:* students discuss course material and help each other;
- lecturers and TAs moderate the discussion and contribute;
- link is on Learn, all currently enrolled students should be signed up.

Preview for next time: Pizza Problems

Pizza Problems

Pizza Solution

a

Two 12” pizzas

b

One 18” pizza

Pizza Solution

a

Two 12” pizzas

$$\text{Area} = 2 \times \pi 6^2 = 226\,\text{in}^2$$

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One 18” pizza

$$\text{Area} = \pi 9^2 = 254\,\text{in}^2$$

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Guest, O., & Martin, A. E. (2021). How computational modeling can force theory building in psychological science. Perspectives in Psychological Science 16(4), 789–802. Listen to the talk here.