Welcome to Computational Cognitive Neuroscience (CCN). I hope you’ll enjoy the course. I have the learning goals specified below. To attain these learning goals, we will use a variety of methods including in-class discussion, discussion over twitter, analyses in matlab, lecture, and a written paper. This course is worth 5 ECTS, which means that I expect you to work on it for about 12.5-15 hours per week on average (including during the 3 exam weeks).

To optimize your learning experience, I try to make this course as interactive as possible. The general format is that we’ll discuss one or more research papers at every meeting, chaired by one of you (we will make a schedule at the first meeting).

To ensure discussion will happen, I want you to comment on the papers in a social commenting system called Perusall (access via the Course Planner in Nestor). You can comment on lots of different things, and use the following questions as guidance:

- Do I understand the methods the authors use? What do I not understand?
- Do I understand the figures?
- Do I believe the methods?
- Do I interpret the results in the same way as the authors?
- Do I agree with the theoretical framework the authors use?
- What implications do the results have for my understanding of the topic?
- How do these results bear on what we discussed earlier in the course? (or anywhere else?)
- You can also ask questions, or answer questions of other students

Although I do not make attendance a formal requirement, as you can see, attending class is pretty helpful for actually learning something and for passing the course.

The practical is not obligatory, but I will lecture a bit about EEG to the extent it’s necessary, and then be available for questions.

*General learning goals:*
• Justify the use of computational models in cognitive neuroscience.
• Reason about several computational models of cognition.
• Conduct a simple EEG analysis.
• Judge which of these EEG analysis methods are useful to assess perform
  a specific model-based analysis.
• Evaluate CCN research.
• Design a CCN experiment.

Specific learning goals by week (subject to change):

week 1: Introduction
  – Becoming familiar with Matlab if necessary.
  – Knowing what CCN is
  – Defending the CCN approach
  – Reading Wed: Ashby & Helie (2011)—focus only on the principles discussed; skim the biological details

week 2: Reinforcement Learning (RL)
  – Introduction to EEG principles.
  – Becoming familiar with Fieldtrip.
  – Reading Mon: Niv et al. (2012)
  – Using RL models

week 3: Free recall (FR) in fMRI
  – Knowing basic principles of fMRI
  – Understanding the basics of the Temporal Context Model of FR
  – Understanding how TCM has been mapped to the brain
  – Reading Mon: Polyn & Kahana (2008)
  – Reading Wed: Manning et al (2011)

week 4: Predictive coding
  – Understanding the theories of predictive coding
  – Reading Mon: Friston (2009)
  – Reading Wed: Wacogne et al. (2012)

week 5: ACT-R
– Describing the relation between modules of ACT-R and the brain.

week 6: DDM and EEG/fMRI.
– Knowing neural correlates of DDM in EEG
– Knowing neural correlates of DDM in fMRI

week 7: Spatial cognition
– Understanding the concept of place cells
– Understanding how place cells can help spatial navigation

Assignments
The assignments are designed to give you practical experience with the analysis of neural data. We will use Matlab in combination with the Fieldtrip toolbox that was created to analyze EEG data. In these assignments, you will analyze a set of given data and write a short report (centered around the questions in the assignment) in which you interpret your results.

More detailed instructions can be found on Nestor under Content → Assignments. Although you are welcome to collaborate, you should each hand in a piece of work from which your own personal understanding is evident. Late submissions are not accepted. If you have a valid excuse for why you cannot submit in time (e.g., seriously ill), contact the instructor well before the deadline.

Assignment 1:  • Do EEG preprocessing
  • Filtering
  • Plot ERP

Assignment 2:  • Oscillatory analysis of EEG
  • Functional connectivity and synchronization

Assignment 3:  • Multivariate pattern analysis

Final paper: Write a research proposal in the area of Computational Cognitive Neuroscience. This means that the proposal should combine a computational theory of cognition with some neural measures. The research proposal should follow the general grant proposal format, comprising of the sections main aims, background, methods, expected results. For such
a proposal it is important that you demonstrate why your question is interesting, and that you know the literature well. To facilitate writing, we implement a peer review system. Before handing in the final version, you will send your paper to a fellow student who is your peer reviewer and who will review your paper and give feedback. You will submit both your final paper and the feedback you gave to another student, and both will count toward your grade. The deadline for the final paper is June 30th, and more information is in the section “Final Paper” under “Content” on Nestor.

Schedule

Monday 13:00–14:45 - Linneausborg 5173.0045
Wednesday 11:00–12:45 - Energy Academy 5159.0114
Practical: Friday 11:00-12:45 - Nijenborgh 4 (5116) room 303

Submission deadlines

You are not allowed to submit assignments after the deadline, unless there is a legitimate reason. If you are sick or think you have have another valid reason, contact the course instructor well in time to request an extension.

Readings

Original research papers provided on Nestor. At the first meeting, you will all be assigned to a week to present a paper. In the second week of classes, I will give an example of how to present a paper for discussion.

Software

Matlab in combination with open source Fieldtrip toolbox for EEG analysis.

Grading

Your course grade will be determined by the following components:

• Participation in in-class and online discussions. This includes preparing a discussion on at least one of the papers and sending discussion points to the other presenters via Perusall- 30 points

• Quality of the three assignments - 45 points
• A final written paper - 25 points

Note that since class participation forms such a large part of your grade, it is advisable to attend most of the classes.

**Plagiarism**

It is allowed to work together, but you are required to submit your own assignments, and it should be clear that those are your own ideas and reasonings. This means you are not allowed to submit assignments which look very much like that of a fellow student. This also means that you should not show your answers to other students; collaboration means talking about the assignments, not copying them. You are also not allowed to exactly copy any corrections you have received from the student assistants in previous years directly into this year’s assignment, since it does not demonstrate whether you understand the material. Finally, plagiarism also includes copying sentences and paragraphs from online and offline sources. In case of a detection of plagiarism, we will notify the exam committee, who may proceed to exclude you from the course.

**Contact information**

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