Syllabus Computational Cognitive Neuroscience

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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 send questions or comments about the paper through twittering with hashtag `#kimccn` (deadline for this is the day before the meeting to give the presenters a chance to incorporate the comments in their presentations). Note that you can also tweet about what you don't understand, and respond to other students. **Interaction is encouraged** and will yield better grades! (if you're not familiar with twitter, check out this tutorial: `http://chronicle.com/blogs/profhacker/how-to-start-tweeting-and-why-you-might-want-to/26065`). Be sure that your tweets are not protected. If you're uncomfortable with using your twitter ID for the course, make a new ID that you use only for this course. How do you come up with questions? Think for example about the following:

- Do I understand the methods the authors use?
- 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?

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

week 2: NEMo and EEG

  - Introduction to EEG principles.
  - Reading Tue: Ashby & Helie (2011)
  - Becoming familiar with Fieldtrip.
  - Describing neural correlates of NEMo.
  - Reading Fri: Nosofsky et al. (2012)

week 3: Reinforcement Learning (RL)

  - Knowing basic principles of fMRI
  - Using RL models
  - Reading Tue: van Vugt et al (2012),
  - Reading Fri: Niv et al. (2012)

week 4: Free recall (FR) in EEG and fMRI and EEG

  - Reading Tue: Talmi et al (2011)
  - Understanding the basics of the Temporal Context Model of FR
  - Understanding how TCM has been mapped to the brain
  - Reading Fri: Polyn & Kahana (2008)

week 5: ACT-R and fMRI (multi-tasking).

- Reading Tue: Manning et al (2011)
- Describing the relation between modules of ACT-R and the brain.
- Reading: Mon: Anderson et al (2008)

week 6: DDM and EEG/fMRI.

- Reading Tue: Borst et al (2011)
- Knowing neural correlates of DDM in EEG
- Knowing neural correlates of DDM in fMRI
- Reading Fri: Ratcliff et al (2009)

week 7: DDM continued

- Reading Tue: Mulder et al (2012)
- Understanding the concept of place cells

week 8: Single-cell neurophysiology and spatial navigation

- Understanding how place cells can help spatial navigation
- Reading Tue: Bush et al (2014)
- Reding Fri: Gupta et al. (2012);

1 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 accepted but will incur a penalty of 1 (out of 15) points per day.

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 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.

2 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.

3 Software

Matlab in combination with Fieldtrip toolbox for EEG analysis.

4 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 twitter - 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.

5 Schedule

Check the FWN schedule! Tuesday 11:00–12:45 -Bernoulliborg room 222
Friday 11:00–12:45 - Bernoulliborg room 222
Practical: Wednesday 15:00-16:45 - Nijenborgh 4 (5116) room 303

6 Contact information

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