

# Cognitive Maps Seminar Syllabus

## Instructors

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## Teaching Assistant

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## Schedule

Location: **4th floor seminar room, AI building, Maria-von-Linden-Str. 6, D-72076**

## Tübingen

Class time: **Wednesdays 16:00-18:00**

Office Hours: Charley (Fridays 14:00-15:00)

## Course description and prerequisites:

The aim is to discuss foundational ideas and current research on cognitive maps, which is an area of much current interest across neuroscientific and computational research fields. Originating in rodent navigation tasks, the concept of a “cognitive map” describes the biological and algorithmic mechanisms of storing and generalizing knowledge. Today, cognitive maps are associated with a host of specialized cell types in the hippocampal-entorhinal cortex, observed across a wide range of species, and across different spatial, conceptual, and diverse representational domains. Key open questions are how diverse experiences can be organized into a cognitive map, which then informs behavior in novel and complex settings.

The first half of the semester will be focused on teaching foundational concepts and research on the topic of cognitive maps and reinforcement learning. Then, we will switch to discussing current research trends and state of the art research for the second half of the semester. The instructors (Wu & Schwartenbeck) will lead the first sessions, and then students will be asked to prepare paper presentations for remaining sessions. Each class will take 2 hrs, and grading will be assigned on the basis of paper presentations and contributions to discussions.

## Grading

- [Required] Attendance at 80% of sessions
- [30% of grade] Submit 1 engaging discussion question prior to every paper session (16. November onwards). Questions will be given in advance to the presenters, which should be included in the discussion
- [70% of grade] Give one presentation (90-minute session with discussion) on a relevant paper of your choice. This can be completed on your own or in a group of 2-3 students, depending on the size of the class

## Preliminary Schedule

Wednesdays from 16:00 - 18:00 (see [semester schedule](#))

Date	Host	Topic	Required Readings
19. Oct 2022	Charley	Introduction to cognitive maps	<a href="#">Tolman, E. C. (1948). <b>Cognitive maps in rats and men.</b> Psychological review, 55(4), 189.</a>
26. Oct 2022	Philipp	What is a cognitive map? An overview of modern neuroscientific discoveries	<a href="#">Behrens, T. E., Muller, T. H., Whittington, J. C., Mark, S., Baram, A. B., Stachenfeld, K. L., &amp; Kurth-Nelson, Z. (2018). <b>What is a cognitive map? Organizing knowledge for flexible behavior.</b> Neuron, 100(2), 490-509.</a>
2. Nov 2022	Charley	Introduction to Reinforcement Learning	<a href="#">Chapter 1 of Sutton, R. S., &amp; Barto, A. G. (2018). <b>Reinforcement learning: An introduction.</b> MIT press.</a>
9. Nov 2022	Philipp	Neuroscience of RL	<a href="#">Daw, N. D., &amp; Shohamy, D. (2008). <b>The cognitive neuroscience of motivation and learning.</b> Social Cognition, 26(5), 593-620.</a>
16. Nov 2022	Noémi	Between model-free and model-based	<a href="#">Stachenfeld, K. L., Botvinick, M. M., &amp; Gershman, S. J. (2017). <b>The hippocampus as a predictive map.</b> Nature neuroscience, 20(11), 1643-1653.</a>
23. Nov 2022	Guest Instructor	Linking memory and navigation	<a href="#">Buzsáki, G., &amp; Moser, E. I. (2013). <b>Memory, navigation and theta rhythm in the hippocampal-entorhinal system.</b> Nature neuroscience, 16(2), 130-138.</a>

30. Nov 2022	Nir Moneta (MPI Berlin)	Cognitive maps beyond spatial stimuli	<a href="#">Constantinescu, A. O., O'Reilly, J. X., &amp; Behrens, T. E. (2016). <b>Organizing conceptual knowledge in humans with a gridlike code.</b> <i>Science</i>, 352(6292), 1464-1468.</a> [Optional] <a href="#">Doeller, C. F., Barry, C., &amp; Burgess, N. (2010). <b>Evidence for grid cells in a human memory network.</b> <i>Nature</i>, 463(7281), 657-661.</a>
7. Dec 2022	Philipp	Student led presentation 1	(We will provide a list of recommended papers)
14. Dec 2022	Philipp	Student led presentation 2	
11. Jan 2023	Charley	Student led presentation 3	
18. Jan 2023	Charley	Student led presentation 4	
25. Jan 2023	Charley	Student led presentation 5	
1. Feb 2023	Charley	Student led presentation 6	
8. Feb 2023	Charley	Student led presentation 7	