BIO-493

Scientific project design in integrative neurosciences

Petersen Carl

Cursus	Sem.	Type
Life Sciences Engineering	MA1, MA3	Opt.
Neuro-X minor	H	Opt.
Neuro-X	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	1 weekly
Exercises	3 weekly
Number of positions	**24**

It is not allowed to withdraw from this subject after the registration deadline.

Remark

only one registration per student to a scientific thinking course

Summary

In this course, students will investigate causal neuronal network mechanisms underlying sensory-guided decision-making in mice. Students will analyse published data to develop integrative neuroscience research projects including the design of new experiments to test specific falsifiable predictions.

Content

Neurons function in highly-distributed brain-wide networks which process sensory information and guide flexible goal-directed behavior across diverse timescales according to animal needs in different contexts. New technologies provide increasingly high-resolution measurements of the activity of many individual neurons measured simultaneously across different brain regions offering unprecedented opportunities for investigating neuronal network dynamics. High-density multichannel silicon probes for electrophysiological measurement of extracellular potentials can provide access to the action potential firing times of hundreds of neurons measured simultaneously with millisecond precision during quantified mouse behavior in sensory decision-making tasks. Such data begin to offer the first insights into how dynamic brain-wide neuronal computations might underlie simple cognitive functions, and in this course we will explore two such data sets. We will first discuss relevant literature, and then re-analyse the underlying data to reproduce and extend key published findings. Guided through discussions in class, students will then develop hypotheses for causal neuronal mechanisms underlying specific aspects of the data. Finally, students will design new experiments, models, simulations, and analyses to test specific falsifiable hypotheses.

Students will work together in small groups to write a joint ~20 page report to be handed in by the end of the semester, which will count for two-thirds of the final grade. Each individual student will also give a ~20 minute oral presentation during the semester, which will count for one-third of the final grade.

A further key goal of this course is to stimulate independent student thinking and to enhance problem solving capabilities. In addition, the course provides an important component of working together with other students as a team. Learning to organize team work and to recognize strengths of team members is therefore also a critical component of the project success.

Keywords

Causal mechanisms of brain function; Mouse behavior; Neurophysiology; Neuronal network dynamics; Group work

Learning Prerequisites

Recommended courses

BIO-482 Neuroscience: cellular and circuit mechanisms

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze scientific papers and understand their methods
- Investigate information across different conceptual levels in neuroscience
- Design new experiments to test specific hypotheses

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Set objectives and design an action plan to reach those objectives.
- Communicate effectively, being understood, including across different languages and cultures.
- Give feedback (critique) in an appropriate fashion.
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking
- Make an oral presentation.
- Write a scientific or technical report.

Teaching methods

The teachers and students will discuss topics in weekly meetings.
Students will work together in groups of ~5 people to solve the selected challenge.

Expected student activities

Students need to develop an idea that they will explore in more detail through literature searches and data analysis, with teachers providing advice and guidance.
Students are expected to attend the weekly 2x45 minute classroom sessions, as well as meeting each week with their group for an additional 2 hours of discussion in their own time.

Assessment methods

Each group of students should jointly write a 20-page report.
Each individual student should give a 10-minute oral presentation followed by 5 minutes of discussion

Supervision

Office hours	No
Assistant.e.s	No
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Moodle Link

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