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Bi23 Section 6: Methods in Neural Data Analysis

Course Syllabus – Winter / 2019

Division of Biology and Biological Engineering, California Institute of Technology

Course Instructor
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Office: BBB B101 (Neurotechers lounge)
Office Hours: Tuesdays from 5-7pm

Course Description

Recent new technologies like multi-unit electrophysiology and calcium imaging have made it possible to simultaneously record from hundreds of neurons in a behaving animal. But what can we learn from all of these data? This tutorial will consist of a series of hands-on workshops introducing common data analysis methods from neuroscience. Topics will include toolboxes for processing raw data, event-triggered analyses, neural encoding and decoding, generalized linear models, and dimensionality reduction and latent variable models. Some familiarity with MATLAB or Python is recommended to follow along, but not required. Students are welcome to bring or share their own datasets, or existing calcium imaging data may be provided.

Course Welcome

Welcome to Methods in Neural Data Analysis! The goal of this course is to introduce you to standard analysis methods used in exploring and interpreting recordings of neural activity. Class format will be a combination of lectures and in-class group problem sets, during which you will use the methods covered in lecture to see what you can uncover in recordings of neural activity from a variety of experimental datasets. At the end of each two-week module, each group will give a short (~10-minute) presentation on what they found in their analysis.

Learning Outcomes

By the end of this course, students will be able to:

- Load and explore real-world neural recording data.
- Implement common techniques in neural data analysis (including generalized linear models, decoders, and dimensionality reduction methods.)
- Understand the relationship between concepts in neuroscience (population coding, receptive fields, neural spiking properties, etc) and the methods used in analyzing neural recording data.
- Quickly assess new neural data to look for interesting phenomena and test hypotheses.

Required Text

No textbook required. See course website for links to helpful reading material.

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Course Website
https://annkennedy.github.io/bi23_2019.html
Suggested reading for the course will be posted to the website by the Tuesday before each lecture.

Assessment Rubric
This is a pass/fail course, where grading will be based on consistent attendance and participation in the lectures/coding work.

Attendance and Participation
This class will have lecture and hands-on components; during the latter, students will be divided into groups to work on shared problem sets.

Honor Code
"No member of the Caltech community shall take unfair advantage of any other member of the Caltech community."

Collaboration Policy
Collaboration during class is expected and encouraged!

Students with Documented Disabilities
Students who may need an academic accommodation based on the impact of a disability must initiate the request with Caltech Accessibility Services for Students (CASS). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact CASS as soon as possible, since timely notice is needed to coordinate accommodations. http://cass.caltech.edu/. Undergraduate students should contact Dr. Lesley Nye, Associate Dean of Undergraduate Students (administrative contact: Beth Larranaga) and graduate students should contact Dr. Kate McAnulty, Associate Dean of Graduate Studies (administrative contact: Angelica Medina-Cuevas).

Course Schedule

Week	Date	Lecture Topic
1	1/18	Preprocessing, loading, and browsing neural data; event-triggered averages.
2	1/25	
3	2/1	Capturing response properties of individual neurons with generalized linear models.
4	2/8	
5	2/15	Looking for information in neural populations with decoding analyses.
6	2/22	
7	3/1	Studying the structure of neural population activity with dimensionality reduction and latent variable models.
8	3/8	

Group presentations of your data analysis results will take place during the second half of lecture on weeks 2, 4, 6, and 8.