

Bio 410/510: Analysis of Neural Data

Spring 2018,

CRN:35933/35934

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Course webpage: <https://canvas.uoregon.edu/courses/110145>

Readings and homework assignments will be posted here, and emailed to class.

Lecture: Tue 10:00-11:20am (ESL 107). **Computer Lab:** Thu 10:00-11:50am (KLA 5).

Office hours: Wed 1:00pm-2:30pm (starting in week 2), in 238 Huestis Hall.

Prerequisites: Pre-reqs BI 211-214 or BI 281H-283H, and calculus (Math 246-247 or Math 251-252). Additional suggested (not required) pre-reqs Math 243 or BI 399 Experimental Design & Stats.

Course description: Modern biology and neurobiology are quantitative fields that rely heavily on statistics and modern methods for data analysis. Neurons (nerve cells) respond to stimuli, and their activities depend on sensory and behavioral variables in complex ways. Moreover, the patterns of these dependencies can be very diverse across different neurons even in the same brain structure. To make sense of these diverse dependencies we need principled regression, classification and clustering techniques. With recent advances in imaging and electrophysiological recording technologies, neuroscience labs can produce very high-dimensional datasets containing the simultaneous activities of many neurons or local neural populations. To gain understanding from such complex data we need principled ways of simplifying and visualizing them in principled ways. That is what dimensionality reduction methods allow us to do.

This course will introduce students to modern methods for data analysis (including regression, clustering and dimensionality reduction) at both the conceptual and practical levels. In the lecture in each week new mathematical concepts (from linear algebra, probability theory or statistics) or new statistical methods will be introduced at the theoretical/conceptual level. Students will then learn the practicalities of applying the methods to data in the hands-on computer lab on Thursdays. The computer lab will also introduce students to the basics of programming in MATLAB. Even though examples and applications come mainly from neurobiology, the methods are quite general and in particular are routinely used in analyzing other types of biological data too.

Homework: Homework assignments will be due weekly. Assignments include programming problems and math questions, and will be emailed to class on Thursdays or distributed during the computer lab. They will be due by midnight of the next Thursday. Scoring may be based on a randomly selected subset of homework problems.

Workload: Class attendance, home readings, weekly assignments. An average well-prepared student should expect to spend about 12 hours per week on this class (including time spent in class).

Exams: There will be a mid-term and a final exam, similar in format to homework assignments, which will be held and completed during the Thursday lab sections in **weeks 6 and 10**.

Grading: Your cumulative score will be based on homework, 40%, mid-term exam, 30%, and the final exam, 30%.

Grades are based on: A (90-100), B (80-89), C (70-79), D (60-69), F (< 60).

Learning Environment: The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic Conduct: The code of student conduct and community standards is at conduct.uoregon.edu. In this course, it is appropriate to help each other on homework as long as the work you are submitting is your own and you understand it. It is not appropriate to copy verbatim someone else's homework and hand it in as your own. It is not appropriate to help each other on exams, to look at other students exams, or to bring unauthorized material to exams.

Topics covered:

- Vector algebra (addition, norms, projections)
- Vector spaces (projections, linear combinations, linear transforms)
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