PSY 4/596L - Computational Neuroscience: Neural Data Analyses

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Spring 2022: Wed, 9:00am-12:00pm, PSYCH 323

http://amygdala.psychdept.arizona.edu/IntroData/

Course Goals

Major advances in neuroscience are often accompanied by new and creative ways of analyzing and displaying data. This course will cover the basic methods available for the analyses of point processes (e.g. single unit and multi-units neural recordings). The course will be divided into a theoretical portion, where the methods and their limitations will be discussed and a practical portion where students will be required to implement them. Work will be based on actual and simulated neural data. Knowledge of Matlab is *required*, knowledge of some basic neurobiology is recommended.

Texts: The course is constructed around key/classical publications accessible online.

Suggested support textbooks (not mandatory):

Theoretical Neuroscience (Dayan and Abbott)
Mathematics for Neuroscientists (Gabbiani and Cox)
Matlab for Neuroscientists (Wallisch et al.)
Neuroscience (Purves et al.)
Numerical Recipes in C (Press, Teukolsky,Vetterling, Flannery)
Spikes (Rieke et al.)

Grading Policy:

There will be 1 midterm exam, 1 final, 1 end-of-semester project and homeworks. Few quizzes will be for extra credits. The final is comprehensive. Midterm and final exams cover assigned readings and lecture material. The final grade will be assigned as follows:

- Final	**30 %**
- Midterm	**20 %**
- Final project (grad students only)	**20%**
- Homework + class participation	**30 % for grad students, 50% for undergraduates**

Syllabus Outline (subject to change, see website)

Week1 Introduction to biophysical neurons and neural networks

Week2 Basic recording techniques: single and multi unit data. Generating your own data: surrogate datasets, NEURON simulations.

Part I: Single unit data analyses

Week3 Spontaneous activity: Spike count, firing rate, CV, return maps, fano factor.

Week4 Stimulus driven activity: Histograms, spike triggered average, PSTH.

Week5 Reverse correlations, tuning curves, receptive fields, discriminability and ROC curves.

Week6 Rhythms and oscillations, autocorrelation, field potentials, power spectra and spectrogram.

Week7 Spike timing and spike patterns. Reliability, precision.

Week8 Displaying single unit data and analyses. **Midterm**.

Part II: Multi-unit data analyses

Week9 Population vectors, cortical maps.

Week10 Dimension reduction: PCA and ICA.

Week11 Cross correlations, joint-PSTH, synchrony, explained variance and coherence.

Week12 Introduction to information theory. Measures of information (Shannon Vs Fisher).

Week13 Displaying multi-unit data and analyses.

Week14 Projects presentations.

Attendance Policy
Attendance records will not be collected but regular attendance of lectures is considered essential for satisfactory understanding of the material.
All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean designee) will be honored. Make up exams will only be allowed in cases of well-documented emergencies, with approval of the instructor. Make up exams will be modified from the original and given as close to the exam date as possible.

Classroom Behavior and Classroom Policies Regarding Effective Learning:
Students are expected to adhere to the Code of Academic Integrity. The policies related to such issues as cheating and plagiarism will be strictly enforced. Read the full Code at: http://deanofstudents.arizona.edu/codeofacademicintegrity
In addition, individuals in groups can learn best when all are considerate of each other. Therefore, we ask that you please make every effort to make the environment in the classroom conducive to effective learning. This includes such things as turning off your cell phone, only using your laptop for class related activities, refraining from conversation that is not geared toward the topic of the day, arriving on time, and leaving when class is finished. Read the full Student Code of Conduct at: http://deanofstudents.arizona.edu/policiesandcodes/studentcodeofconduct

Students with Disabilities
If you anticipate barriers related to the format or requirements of this course, please meet with the instructor so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; drc.arizona.edu) and notify the instructor of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

Student Code of Academic Integrity
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity.
See: http://deanofstudents.arizona.edu/tipsforavoidingacademicdishonesty

Confidentiality of Student Records
http://www.registrar.arizona.edu/ferpa/default.htm

Subject to Change Statement
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor. Any changes to the syllabus will be announced in class and posted on the class website.