Welcome: Spring 2022

Welcome to Psych 496/596L! Introduction to Neural Data Analyses

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Wednesdays: 9:00am-12:00pm
Psychology 323

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

Code, original data, PDF files are/will be secure. Please do not distribute….

Goal: Basic data analyses of 'point processes'. Emphasis on systematic quantitative thinking, visualization, organization, interpretation.

Textbooks: None. This is a hands on class…. However:

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)

Other requirements: Matlab (easy access), NEURON, Excel (easy access)… Word processor

The plan

1/12 - Class1: Introduction to biophysical neurons and neural networks.
1/19 - Class2: Basic recording techniques: single and multi unit data. Generating your own data: surrogate datasets, NEURON simulations.

Part I: Single unit data analyses
1/26 - Class3: Spontaneous activity: Spike count, firing rate, CV, return maps, fano factor.
2/2 - Class4: Stimulus driven activity: Histograms, spike triggered average, PSTH.
2/9 - Class5: Reverse correlations, tuning curves, receptive fields, discriminability and ROC curves.

2/16 - Class6: Rhythms and oscillations, autocorrelation, field potentials, power spectra and spectrogram.
2/23 - Class7: Spike timing and spike patterns. Reliability, precision.
3/2 - Class8: Displaying single unit data and analyses. **Midterm**.

Part II: Multi-unit data analyses
3/9 - NO CLASS
3/16 - Class9: Population vectors, cortical maps.
3/23 - Class10: Dimension reduction: PCA and ICA.
3/30 - Class11: Q&A and discussion about projects
4/6 - Class12: Cross correlations, joint-PSTH, synchrony and coherence.
4/13 - Class13:Introduction to information theory. Measures of information (Shannon Vs Fisher).
4/20 - Class14: **Projects presentations**.
4/27 - Class15: **Projects presentations**.

5/4 - **Final exam**.

The grading

Prerequisite: Some basic knowledge of Matlab (or any other 'standard' computer language). Some basic knowledge of neuroscience (neurophysiology).

Self test:
- Generate an array of 1000 real/float random numbers between 1 and 10.
Plot the array.
- Compute and plot a histogram (say bins are 0.1 wide) of the differences between 2 consecutive points of the array.
- Sort it in ascending order. Compute its mean and standard deviation.

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

Class participation = ask questions/'participate' + present paper/data analyses

Unit 1: Crash Neuroscience

Crash lectures in basic Neuroscience

1- The Neurons
2- The Synapses
3- The Brain
4- Methods in Brain Research

For next class….

- Download and Install NEURON (neuron.yale.edu). No need to go through the tutorials… but feel free … Test that it is working (run ‘NEURON Demo’)
- Install Matlab. Do the Self Test (see webpage).

Readings presentations

One or Two papers assigned each week, plus a number of optional papers. One of the 2 papers (or both) will be presented in class. Goal: introduce the topic for the week (and practice your scientific presentation skills)

- 20-30 minutes
- Focus on the figures: What are the 'take-home' messages. Copy/paste figures. OK to skip a few panels in the interest of time (but give the main message)
- Give 2-3 slides of introduction
- Give 2-3 slides of discussion

- No need to present supplemental information
- Each student will give a presentation in Part I and Part II
- Sign up ASAP (1st come, 1st serve). If no-one signs up, the papers will be assigned. Swaps are allowed.

- Next week: 1 paper. Given the circumstances, if no-one signs up, we will skip the 1st presentation.