CPNS 35600

Problem Set 1

On the Canvas website for this course, you will find three datasets you can download and open in Matlab (formatted as a `.mat` file) or python/other programming language (formatted as a comma-separated value or `.csv` file). These each contain an extracellular voltage trace from a cockroach leg experiment performed by the founders of Backyard Brains, or in class. Included are traces from recordings we made in class in 2019 (*I'm bummed that you didn't get to do this!*) with Caleb's iPad (which includes cockroach and EMG data) or with Albert's phone. The Backyard Brains recording is sampled at 32,000 samples per second (Hz). The recordings taken in class were sampled at 44,100 Hz. In both cases, the recorded sample times are in units of seconds. The amplitude of the recording is in arbitrary units. Open these data files and perform a few simple spike sorting tasks.

1. Load the Backyard Brains data set. Plot one second of the data from the full recording. You may select whichever 1-second epoch you choose. Plot `signal_raw` versus `x_time_points`. Also plot `signal_highpass_500Hz` versus `x_time_points` for the same one second of the recording, on a separate plot. Label your axes. What did the high-pass filtering do to the signal?

2. Open and examine the data we recorded during class in 2019. Find what you think is a good part of the recording, with lots of activity/low noise, and plot it as you did in Problem 1. Which recording of the three you have access to do you prefer to analyze and why? For that data set, complete the remaining tasks.

3. Set a threshold on the data to define spiking events. How many events do you detect in this recording?

4. Clip out about 50 or so data points around each event and tag these clips as putative spikes. What is the shape of the average "spike" in your dataset? How many different kinds of spikes do you think there are in these data?

5. Try a rough clustering of these spikes by measuring a simple feature of your clips, such as amplitude. Plot the distribution of amplitudes you find in your clips and report how many "clumps" you see. What other features might distinguish your clips from one another?

Bonus problem: Feed these data into a spike sorting package discussed in class of your choosing and show your results.