Problem Set 3

Pick any two or do all three for extra credit

1. ***Classification of membrane potential features*** – use data from Lab 8 (epfl_challengeC_samp.mat)

    a. Construct a first set of features based on spike timing. Use `findpeaks` to extract the spike times from `voltage_soma`. Calculate the mean inter-spike interval for each of the 14 trials, standard deviation of ISIs, and their ratio. Plot the features.

    b. Construct a second set of features based on `voltage_soma` itself. Calculate the mean voltage for each trial, standard deviation, and their ratio. Plot the features.

    c. Classify the responses on each trial using each of the two feature sets. Recall that the first 7 trials are with no dendritic current and the second 7 are with dendritic current. How accurate is classification based on spike features? Voltage features? Are certain features especially informative?

2. ***Eigenfaces*** – use data from the stevensonlab/teaching/sand/problem_sets folder (lfw2_samp.mat)

    a. `X` contains face images from 1000 people [64 pixels x 64 pixels x 1000 people]. Use `imagesc` to show a few samples from this dataset (Hint: you may need to change `colormap`).

    b. Find and show the mean face.

    c. Use PCA to find the "eigenfaces." Show the first few eigenfaces. (Hint: You'll need to use `reshape` to make a [pixels x faces] matrix and another `reshape` to show the individual PCs)

    d. Plot the fraction of variance explained as a function of the number of PCs. Approximately how many eigenfaces do you need to explain 90% of the variance?

3. ***EEG Source Separation*** – use data from Lab 4 (chb_sample.mat)

    a. Run ICA on this data using the FastICA package in the ps3 folder (Hint: unlike `princomp`, `fastica` takes data of the form [dimensions x samples]). Plot the first 10s of data alongside the first 10s of independent component activations.

    b. Use `kurtosis` to compare the "Gaussianity" of the original data and the ICs. How do they compare?

    c. From Problem Set 1 remember that this data contains a seizure event. Would running ICA first be likely to improve seizure detection? Why?

    d. One application of ICA is in artifact removal. Are any ICs in this data likely to be artifacts?