Ain Shams University
Faculty of Engineering
Computer & Systems Eng. Dept.

CSE 462 – Biomedical Engineering 2018-2019

Assignment #2

(Due on: Saturday, December 29 at mid-night by e-mail)

Implement the spike sorting algorithm explained in Lecture 10.pdf. Your function should take as inputs the raw extracellular activity of multiple electrodes. The function should return a vector that contains the timestamps of the peaks of the detected spikes for each neuron and a vector for the mean spike of each neuron. Apply your function to the data provided at https://ufile.io/kc1yd

Each column in the data file corresponds to one electrode. The sampling rate of this data is 24414 Hz. To detect spikes, compute the threshold as either 3.5 times the standard deviation of the first 500 samples of each electrode, or 5 times the standard deviation of the first 500 samples of each electrode. Spikes should be aligned based on their peak value. Extracted spikes should be of duration 2 msec, where the peak is at the center of the extracted spike window.

Deliverables:

- Your code
- The feature space obtained for each electrode after applying Principal Component Analysis (PCA) to the aligned extracted spikes of each electrode. Use two principal components. Name the figures "FeatureSpace_1_3_5.jpg" for electrode 1 and "FeatureSpace_2_3_5.jpg" for electrode 2 for threshold of 3.5 times the standard deviation, and "FeatureSpace_1_5.jpg" for electrode 1 and "FeatureSpace_2_5.jpg" for electrode 2 for threshold of 5 times the standard deviation.
- A text file stating the number of clusters that you identified by visual inspection of the feature space of each electrode. Name the file "Number of Neurons_3_5.txt" for threshold of 3.5 times the standard deviation and "Number of Neurons_5.txt" for threshold of 5 times the standard deviation.
- A figure showing the first 20,000 samples of the raw data of each channel with an "*" marking the detected spikes colored with different colors depending on the neuron each spike belongs to. Name the figures "DetectedSpikes_1_3_5.jpg" for electrode 1 and "DetectedSpikes_2_3_5.jpg" for electrode 2 for threshold of 3.5 times the standard deviation, and "DetectedSpikes_1_5.jpg" for electrode 1 and "DetectedSpikes_2_5.jpg" for electrode 2 for threshold of 5 times the standard deviation.
- A figure showing the average spike of each neuron colored with different colors. Name the figure "Templates_3_5.jpg" for threshold of 3.5 times the standard deviation, and "Templates_5.jpg" for threshold of 5 times the standard deviation.