

CSCE 363/3611 – Digital Signal Processing

Project

(Due on: December 10, 2023 at mid-night)
(Submit on Blackboard as one .zip file)

Implement the spike sorting algorithm explained in the attached file “Spike Sorting.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 in the file “Data.txt”.

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 3.5 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.

For each spike, extract two features as follows:

- The standard deviation of the samples of the spike
- The maximum difference between two successive samples of the spike

Deliverables:

- Your code
- The feature space obtained for each electrode after extracting the above features from the aligned extracted spikes of each electrode.
- The number of clusters that you identified by visual inspection of the feature space of each electrode.
- 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.
- A figure showing the average spike of each neuron colored with different colors.

Submission:

- Your MATLAB or Python code to be submitted on Blackboard on **December 10 at mid-night**

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- A report (to be submitted on Blackboard on **December 10 at mid-night**) that includes the following:
 - Description of the approach used
 - Outputs of the project as described in the deliverables
- Submission of the above items should be done as one .zip file by the deadline

Guidelines:

- This is a group project. A maximum of 3 students per group is allowed.
- Each team must send an e-mail by **Wednesday, November 29 at mid-night** specifying the members of the team.
- **Changing teams will not be allowed.**
- Project evaluation will occur in the class of **December 11.**
- Project grading will be as follows (out of 15):
 - 5 points on the code submitted
 - 5 points on the submitted report
 - 5 points on the evaluation and discussion