**Rules**

**The challenge: PSTH**

Neurons in the brain integrate the excitatory and inhibitory input from numerous other upstream neurons. Each neuron transforms its analog inputs into action potentials events that occur across a range of frequencies. Additionally, these action potentials may be precisely timed in relation to one another.

In neuroscience, one common method for calculating a neuron's response to input is to generate a peri-stimulus time histogram (PSTH; Figure 1). This probability distribution reflects the probability that the neuron will generate an action potential during a given time interval (bin) before and after stimulus event. Additionally within each time bin, the average probability across repeated trials of stimulus presentation is represented.

In real world examples, the PSTH is generally noisy and is occasionally difficult to detect above the spontaneous discharge of the neuron. As such it is important to generate accurate detection algorithms that can replace human interaction.

**Figure 1:**

Quantitative analysis of PSTHs. This histogram illustrates the excitatory response of a single thalamic neuron to electrical stimulation (0 ms onset, \(n=400\) trials) of the contralateral whisker pad. The x-axis depicts time (in 1 ms bins) before and after the stimulus presentation; the y-axis is the probability of neuronal discharge for a given bin. The response of this thalamic neuron began 4 ms post-stimulus and terminated at 26 ms post-stimulus as measured by activity that exceeded the 99% confidence interval (dotted line) for spontaneous firing rate (mean PROBABILITY =0.003). The cell exhibited a 0.48 probability of discharge during the 22 ms response window and reached the maximum discharge rate at 7 ms. Spontaneous firing rate was calculated for 100 ms indicated by the solid bar above the histogram. Copyright CRC Press.

**Your Charge:**

Your job is to write a MATLAB M-file to quantify the area under the curve of neuronal responses. Given an matrix which represents a number of PSTH's, your solution should correctly quantify as many parameters as it can in the shortest amount of CPU time.
In MATLAB syntax, the function header for your solution should look like this:

```matlab
function output = [programmername_date]_PSTHcalc(input);
```

where `programmername` is your surname and `date` is the revision date.

**Input:**

You will be given a `[1000 x n]` matrix. Each of the 1000 rows representing a time bin (the stimulus event occurs at bin 500. Each of the n columns represent a single PSTH plot.

Sample matrices can be found at: https://mywebspace.wisc.edu/ddevilbiss/web/contest

**Output:**

A matrix containing the following results:

`[PSTH number, peak bin, height of peak, onset bin, termination bin, AUC]`

`e.g. ([1, 510, 20, 505, 523, 150])`

AUC represents the sum of probabilities found for each bin between termination and onset.

**Judging Criteria:**

The allowable functions are those contained in the basic MATLAB package. These are ones available in `$MATLAB/toolbox/matlab`, where `$MATLAB` is the root MATLAB directory. Entries will be tested against MATLAB version 2007b 64bit. Functions from other toolboxes will not be available, however you can integrate freely available functions into your own code.

The following are prohibited:

- MEX-files
- eval, feval, etc.
- Shell escape such as !, dos, unix
- Handle Graphics commands
- ActiveX commands
- File I/O commands
- Debugging commands
- Printing commands
- Simulink commands
- Benchmark commands such as tic, toc, and flops

Entries will be judged on a combination factors including:

- number of correct answers
- etime()
- profile()
- McCabe Complexity

The winning entry is the one with the most correct answers and the lowest etime(), profile(), and McCabe Complexity scores.

**Submission and Deadline:**

The contest will close on March 1st 2009, at 5 PM central time.
At that time, the contest will be closed to new entries. Have all entries FTP'd to https://mywebspace.wisc.edu/ddevilbiss/web/contest/submissions

your function name (i.e. bob_15Feb2009_PSTHcalc) will identify each submission.

The Prizes:

Prizes will be awarded following the completion of the contest.

The author of the final winning entry in the contest will receive their choice of:

* Something pretty cool

Winning entries must be original or must be substantial improvements over other entries. The contest administrators reserve the right to disqualify trivial changes which happen to result in better scores.