Computational Neuroscience II:
Foundations of Neural Coding

PROF. DR. A.V.M. HERZ, M. STEMMLER PHD

4. Plotting with Matlab

In last week's introduction to Matlab, we familiarized ourselves naming, entering, and manipulating vectors (arrays) and matrices. Plotting involves the creation of two arrays, one containing the data points for the x-axis (horizontal), the other for the y-axis (vertical). So, for instance,

```
>>  t = 0:0.1:6.2;
>>  y = sin(t);
>>  plot(t,y);
```

creates a simple plot of the sine function.

Remember: Matlab help can be gotten by using `lookfor` ⟨search term⟩, `help` ⟨command⟩, or `helpdesk` (listed here in order of increasing generality).

- Start your engines (i.e., turn on the computer, if necessary). Open up two Xwin32 windows this time. Start matlab in one of them, by typing in 'matlab' at the Linux prompt.

- If you haven't done so already, type `demo` at the Matlab prompt >> and explore the following demos `MATLAB--{Visualization, Graphics}--2-D Plots: Line/Bar`. Change parameters and execute the commands by typing `Ctrl+return` (explore the "Info button").

- Plot the following function $f(t) = \log(t)$ for $t \in [0.01, 5]$. Assign axes labels and give the plot a title (such as "Logarithm Function").

- Now plot the exponential function

$$\exp(-t/\tau),$$

and the so-called $\alpha-$function

$$\frac{t}{\tau^2} \exp\left(-t/\tau\right)$$

for $t \geq 0$ and $\tau = 2$ msec in the same window. Use different line styles and colors for the two functions. (These two functions represent two commonly used models for describing excitatory postsynaptic currents/potentials when synapses are activated at $t = 0$.)

5. **Simple statistics of neural spike trains**

- In the tutors' directory you will find the files "spiketrain1.dat" and "spiketrain2.dat". Copy them in your home directory with
  "cp /home/tutor/CompNeuroII/Assignment2/spiketrain?.dat ."
  Import them into your matlab environment by typing `sX= load('spiketrainX.dat');`

- The variables sX are column vectors and contain a set of numbers each. We consider them as a time series of spikes obtained from a single neuron. Times are given in units of milliseconds. How many spikes have been recorded into each file?
  Hint:>> `help length`.

- Calculate the overall firing rate (number of spikes / time) of both traces.

- Plot the time-binned histograms of the spike trains by means of the matlab commands `histc` and `bar` for various binsizes. Don't forget axis labels! Is there a difference between both spike trains except overall firing rate?

- Make yourself familiar with `for`-loops (type `help for`). Try to use your new knowledge to calculate the sets of inter spike intervals (=spike time - previous spike time). Plot the histogram of the inter spike interval distribution. *Hint: use* `hist`. Never forget axis labels! Is there a difference between both spike trains?

- Try saving the last plot(s) as a PostScript file, e.g., figureX.ps. If the connection to the printer works (no guarantees here!), you can then send the file to the printer by typing `lpr figureX.ps`.

- Log out and shut down the computer before you leave!

Dr. R. Kempter, Tel. 8924, Raum 2315 `r.kempter@biologie.hu-berlin.de`
Dr. C. Leibold, Tel. 8925, Raum 2315 `c.leibold@biologie.hu-berlin.de`
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