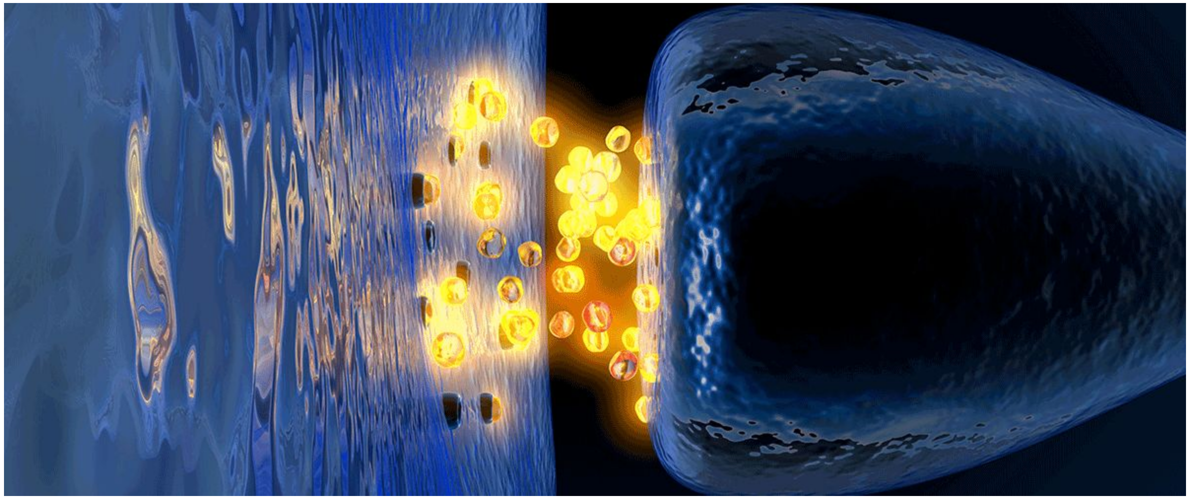
LASCON 2026

Tutorial: Modeling Synapses and Networks



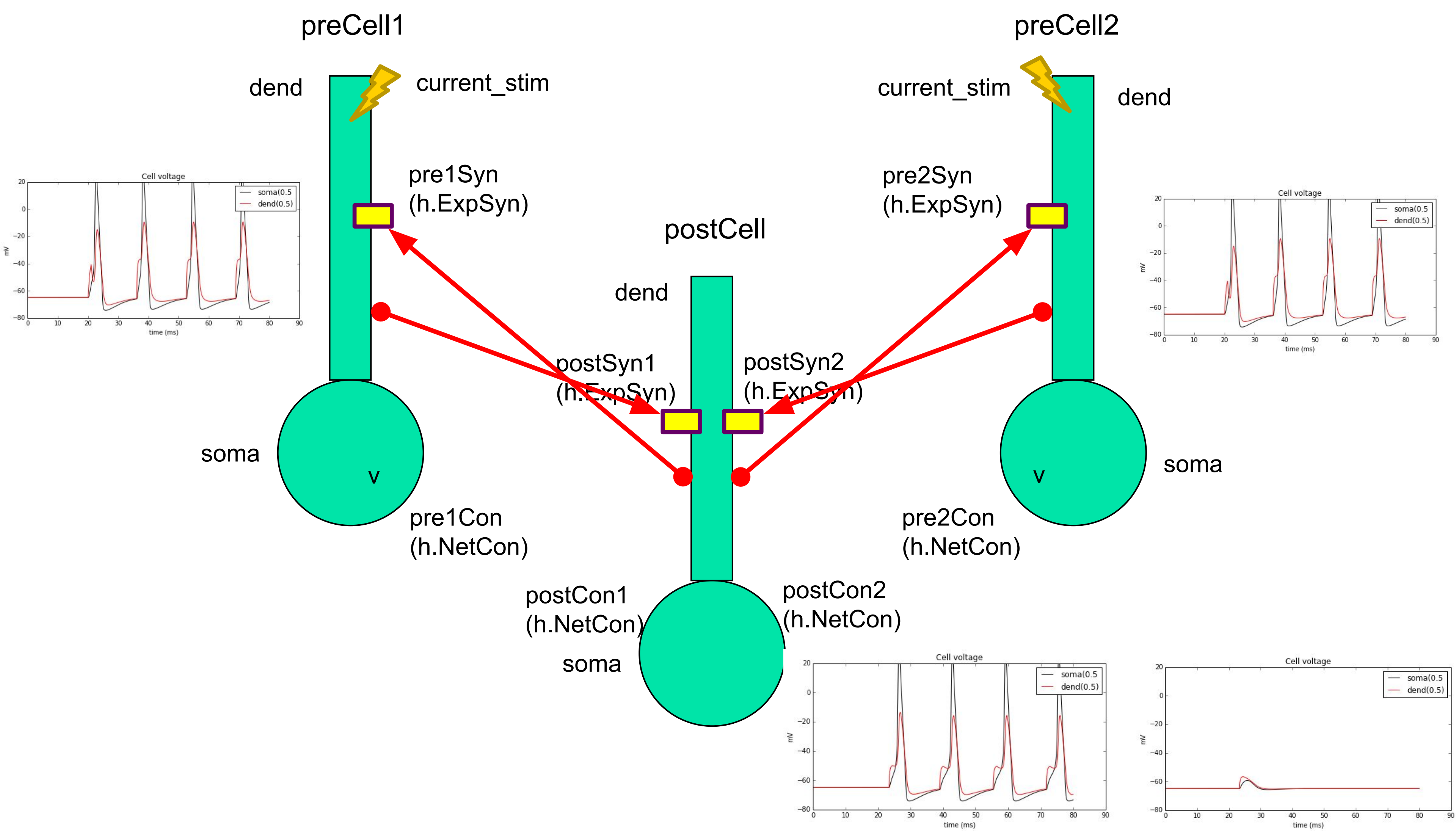
Arnd Roth and Valery Bragin

Networks

The aim is to connect the postsynaptic cell to the 2 presynaptic cells so that we create a loop and they keep firing forever (see diagram in next slide):

1) Start from the file ***tutorial_4a.py***: it's similar to what we used before, but has connection-related code incapsulated into methods for convenience. Recreate the same connections as in previous task using these methods.
2) Adjust the parameters to make both synapses excitatory, and so that the postsynaptic cell fires due to spatial summation (ie. requires input from BOTH presynaptic cells to fire; input from just 1 of them should generate an EPSP but not a spike)
3) Add an excitatory synapse to each of the presynaptic cells, at location 0.5 of the dendrite, with tau of 2 ms.
4) Add a connection from the postsynaptic cell soma to the each of the presynaptic cells (using the synapses created in step 3), each with delay of 10 ms.
5) Run simulation for **80 ms**
6) Adjust the weights as necessary to obtain spike sequence in all the cells as shown in the next slide.
7) Make sure that step 2) still holds true: ie. if you set to 0 the weight of either of the presynpatic cells to the postsynaptic, then the 4 spikes should no longer be there.

Networks



with input from 2 presyn cells
(spatial summation)

with input from only 1 presyn
cell (no spatial summation)

Networks

Using all the previous code, we now can build up to the more sophisticated network:

1) Start from the file ***tutorial_4b.py*.** Inspect new code - ***Pop*** class and new plotting and spike recording.
2) Create two populations and plot the cells.
3) There is no stimulation yet, so the whole network is quiescent.
4) Add stimulation to first population, using NetStim (not to confuse with NetCon)
5) Observe raster plot

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class **NetStim**

Syntax:

```
s = h.NetStim()

s.interval ms (mean) time between spikes

s.number (average) number of spikes

s.start ms (most likely) start time of first spike

s.noise ---- range 0 to 1. Fractional randomness.

0 deterministic, 1 intervals have negexp distribution.
```

Networks

Now we can add connections between populations, to get some activity in the second population as well. Connections can be added in following ways (you can try any one you like more):

1) All-all-connectivity
2) Probabilistic (where p = num_conns/(num_pop_pre*num_pop_2post
3) Convergence or divergence (numConns = num_pop_post * convergence OR numConns = num_pop_pre * divergence)