

Synapse \bullet are excitatory, and synapse \mid is inhibitory.

1 Topology A

This is implemented in file `./minimal_network_topologyA.py`

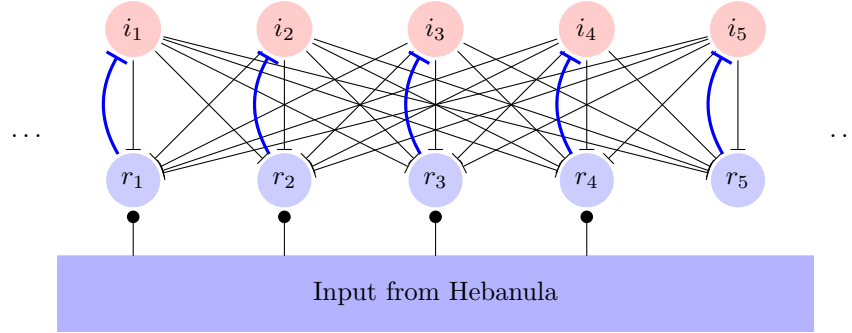


Figure 1: A dense topology

One representative simulation is shown in figure 2.

I probably should do longer simulation

The network shown in figure 1 shows right behaviour but it is probably not the best one. The interneurons in this model makes connections with almost every other Raphe neuron. To overcome this, one can hypothesise that interneurons makes excitatory connections to each other, and inhibitory connections from interneurons to raphe are sparser. This topology is explored in next section.

2 Topology B

This is implemented in file `./minimal_network_topologyB.py`

This topology is bit more realistic than topology A of section 1.

In this network, the interneurons make excitatory connection onto other interneurons in its neighbourhood of radius ¹ 2. Excitatory connections are necessary to spread the influence of a Raphe neurons to other interneurons (since we don't connect to each Raphe neuron as we did in topology A).

And a representative simulation of this topology is shown in figure 4.

3 Notes

- Parameter space in which network shows desired behaviour i.e. One input neuron off \rightarrow Raphe off is tiny. I've not explored it systematically. Also, as expected, a tiny perturbation of parameters can negate the intended behaviour of system.
- Paramters g_i and g_e in brain2 models have very strong effect on network. I don't understand them well yet. Probably a better neuron model (HH types) can be used later.

¹radius n means that $abs(i - j) \leq n$ is satisfied where i and j are indices of interneurons.

Among all input neurons, one neuron shuts down at 4.5 sec shown by red X

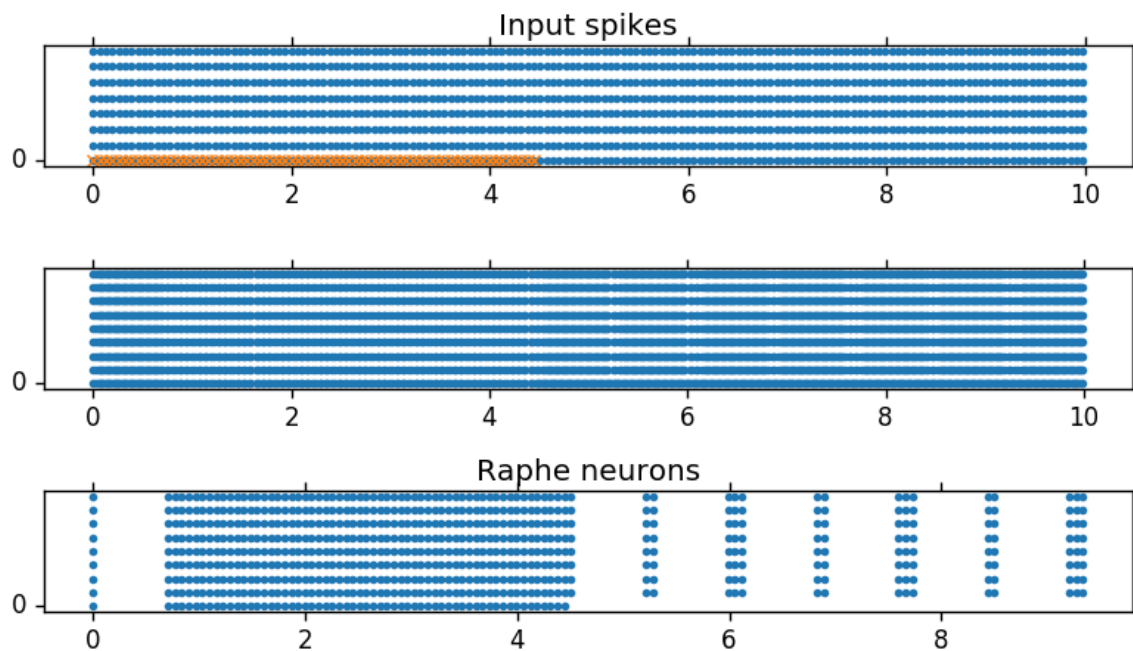


Figure 2: Representative simulation of topology A. The initial part of simulation – upto 1 seconds – can be ignored.

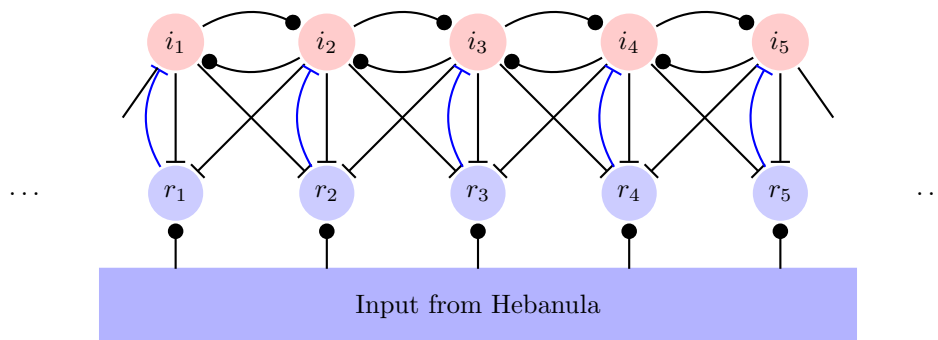


Figure 3:

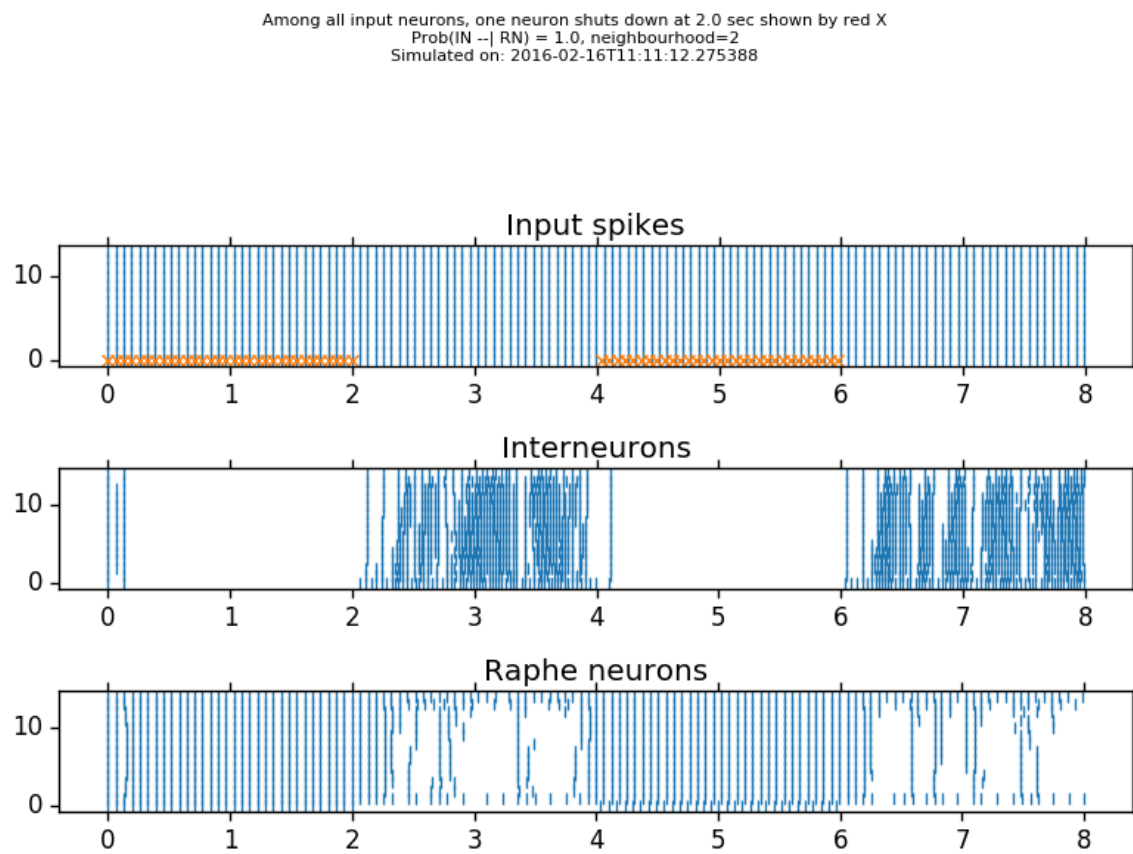


Figure 4: Representative simulation of network shown figure 3.