Computational Neurodynamics

Exercise Sheet 2 (Unassessed)
Connecting populations and Braitenberg vehicles

All the files for these exercises can be found online at

https://github.com/pmediano/ComputationalNeurodynamics

Question 1

a) Start up Python and run `Run2L`. The code that simulates the dynamics of the Izhikevich neurons is in `IzNetwork.py`. Inspect the code in these two files and make sure you understand how it works. Using the output of `update()`, make a spike raster plot of the neural firings.

b) How does the behaviour of the network change if the neurons in one or both layers are inhibitory or bursting?

c) Create a new class `QIFNetwork` that works with quadratic integrate-and-fire neurons instead of Izhikevich neurons. Experiment with the two-layer example and notice the differences in behaviour between both neuron models. To construct a heterogeneous population, introduce some random variation in the v_r and v_c parameters.

Question 2

a) Run `RobotRun4L` and observe a Braitenberg vehicle in action. Inspect the code and make sure you understand how it works. Experiment with the settings and explore how the neural network inside affects the behaviour of the robot (number of neurons, synaptic connections, neuron model parameters, etc.).

b) Alter the network inside the robot so that it avoids objects rather than approaching them.

c) In which cases does the vehicle fail most often? Think about the cases where there is one object at each side of the robot. Using the ideas in the lecture notes modify the neural net inside the vehicle to deal with these cases more effectively.