Report 3-12-2018

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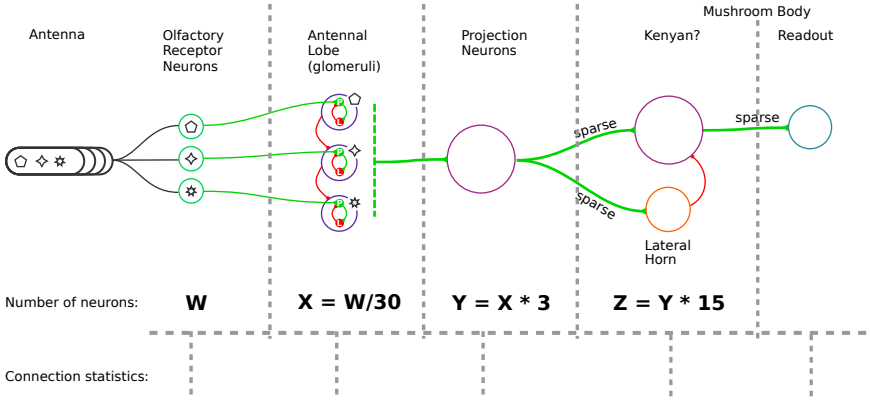
1 Olfactory pathway

Antennae have multiple receptors per chemical; an odour is composed of one or more chemicals. These receptors trigger activity of Receptor Neurons (RNs), this seems to be a one-to-one connection. Many RN reach a single glomerulus (many-to-one connection) which are complex structures in the Antennal Lobe (AL) consisting of both excitatory and inhibitory neurons. Glomeruli connect to projection neurons (PNs) which output signals (spikes?) representing the concentration (?) of a chemical (combination?).



Projection neurons have excitatory, sparse connectivity with neurons in the Mushroom Body (MB). There is lateral inhibition in the MB which keeps activity regulated (sparse?). Output neurons in the MB can classify odours, this is, activity in an output neuron indicates the presence of a combination of chemicals in the antennae.

2 Software environment

I've been looking at software on top of which we can use to build the project instead of developing a full framework ourselves (no need to reinvent the

wheel). I'm currently stuck on getting the HBP portal to run BrainScaleS simulations, not even the example provided in the portal works!

2.1 NEST and PyNN

The default configuration for BrainScaleS (BSS) requires PyNN 0.7 (deprecated); if we want to do tests on the local host with Nest, we need to use version 2.2.2.

`https://github.com/nest/nest-releases/blob/master/nest-2.2.2.tar.gz`

`https://github.com/NeuralEnsemble/PyNN/releases/tag/0.7.5`

2.2 Cypress

Cypress is a spiking neural network simulation framework developed (and for use) with C++. This allows for fast(er?) network building times and all the beauty that comes with a typed, compiled language. This framework can serve as a PyNN wrapper allowing the use of multiple back-end simulators (Nest, Brian, SpiNNaker, BrainScales, etc.); furthermore, the mindset for assembling networks is similar to PyNN 0.8 and up. Unfortunately, Cypress supports Nest only with PyNN 0.8 which makes it a bit incompatible with the default configuration for BrainScales

There is a bug in the `CMakeLists.txt` file

```
- FILES $CMAKE_BINARY_DIR/cypress/config.h
+ FILES $CMAKE_BINARY_DIR/include/cypress/config.h
```

`https://github.com/hbp-unibi/cypress`

2.3 DEAP

Distributed Evolutionary Algorithms in Python (DEAP) is a library which allows the user to easily perform multiple types of evolutionary algorithms. Since it is a Python library it would allow to easily integrate the PyNN-BSS workflow.

`https://deap.readthedocs.io/en/master/index.html`

2.4 Open Beagle

Open Beagle is an evolutionary computing framework for the C++ language. The design/usage philosophy is similar to DEAP and the interaction with

Cypress may (hopefully) be easy.

`https://github.com/chgagne/beagle`

2.5 PaGMO

PaGMO is a C++ (and Python) library for parallel optimization. The main advantage could be that we may use the Python interface for PyNN while keeping the high-performance C++ back-end. Additionally, if this is not possible we could still use C++ with Cypress? Another benefit is that we could jump from Genetic Algorithms to another optimization algorithm such as Particle Swarms or Simulated Annealing.

`https://esa.github.io/pagmo2/`