ASSIGNMENT #1

ECBM E4070, Professor Aurel A. Lazar

Deadline: 11:59AM (Noon), Monday, February 11, 2020

In this assignment you will briefly explore the overall architecture, the early olfactory system and the early visual system of the fruit fly brain by using NeuroNLP, accessible through `https://neuronlp.fruitflybrain.org/`. You are not asked to write a report that includes your responses to all the tasks below; please just answer the questions in Task #3.

Associated with this assignment is a handout, accessible in Courseworks Files under the name `handout1.pdf`, that gives instructions on how to work with `NeuroNLP`. **If you encounter errors when using NeuroNLP or if the website hangs, please send a message to the CAs on Piazza.** Avoid very large queries (>1,000 neurons) if possible.

Task #1: Go through the contents of `handout1.pdf`.

Task #2: In this task, you will learn about the architecture of the fruit fly brain.

- Open NeuroNLP. Press the "Neuropils" button at the top right of NeuroNLP to access a list of neuropils or brain regions. You can hide/unhide them to see where they are, or use the mouse to hover over them. Query "show local neurons in <insert neuropil>" to get the local neurons in that neuropil. Some of the neuropils are associated with specific sensory pathways, which you will explore next.
- For the following subtasks, you will use NeuroGFX, located at `https://neurogfx.fruitflybrain.org/`. First, go to Toggle LPUs > Subsystem and check out the different subsystems and their circuit connections.
- Explore the olfactory subsystem by going to:

  `Toggle LPUs > Subsystem > Olfaction`.

  You will be able to use the abbreviated names you see in the circuit diagram for queries in **NeuroNLP**. To learn more about LPUs you can take a look at `http://dx.doi.org/10.1016/j.cub.2010.11.056`, which has also been uploaded to Courseworks.
- Explore the vision subsystem in the same way, looking at retina, lamina, medulla, lobula, lobula plate and optic glomeruli.

Task #3 (Required): In this task, you will learn about the early olfactory system of the fruit fly.

- Familiarize yourself with the `NeuroNLP` platform by running through the demos. In particular, you need to know how to `pin` neuron, `remove unpinned`, take screenshot, add/remove pre-/post-synaptic neurons, download connectivity.
- Do the following sequentially as shown below and provide a screenshot for each of the tasks (except the last two tasks):
  - Query: `Show local neurons in right AL`. This will give you all local neurons in the right antennal lobe.
  - Pin one of the neurons and remove all unpinned neurons.
  - After removing all unpinned neurons, query:
    `Add all postsynaptic neurons with axons in lateral horn`
    This will give you all the antennal lobe projection neurons (PNs) with axons in a neuropil called the lateral horn which are postsynaptic to the neuron you pinned.
  - Create a tag of the result with a name that includes your Columbia UNI; include the name of the tag in your response to this question.
  - Download connectivity and upload the csv along with your submission.

Task #4: In this task, you will learn about and delve into the early visual system of the fruit fly. NeuroNLP includes data from two different sources: The first is the Janelia Seven Column Connectome dataset, which contains a small part of the retina, lamina and medulla. The second is the FlyCircuit dataset, which includes a subset of the whole brain.

- Now, start by querying "show neurons in lamina". Go to Toggle Neurons > Single Neuron to see a list of the neurons that have been returned. The part of the neuron name before the first hyphen denotes the neuron type. What neuron types do you observe?
- Rotate the screen and highlight the neurons to get an idea about their spatial organization. You can click on neurons to see their presynaptic or postsynaptic partners to get a better idea about how different neurons are connected. What do you observe?

Submission Instructions: Your submission must include

1. A `pdf` file that includes your answers to Task #3.

Name your write-up `assignment1_YOURUNI.pdf` (replace YOURUNI with your UNI) and submit the file to the **Assignments** section of ECBM E4070 on Courseworks.

Please post any questions regarding this assignment on the **Piazza discussion forum**. Your questions and the answers may also benefit the other students in class. If you have any other questions, please do not hesitate to contact the CAs using their emails in the course website.

GOOD LUCK!