

# Neuroscience: Cellular Circuit Mechanisms

## Mini-Project, BIO-482, EPFL

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### I. PROPERTIES OF CORTICAL NEURONS DURING QUIET WAKEFULNESS

Question 1 (1/10 marks):

- 1) Based on what you have learned during the course, explain what could be the impact of the AP threshold, the mean  $V_m$  and the SD of the  $V_m$  on the mean firing rate of a neuron.
- 2) Based on the analyses performed in Part 1, identify which property(ies) actually influence the mean firing rate of cortical neurons across cell-classes? Justify your answer with some graphs.

*A. Suprathreshold activity*

*B. Subthreshold activity*

### II. MEMBRANE POTENTIAL DYNAMICS AND MOTOR ACTIVITY

Question 2 (2/10 marks):

- 1) What are the specificities of each class of cortical neurons allowing to best distinguish excitatory vs inhibitory neurons?
- 2) And between the different subclasses of inhibitory neurons?
- 3) Justify your answers with some graphs.

### III. SENSORY EVOKED NEURONAL ACTIVITY

Question 3 (1/10 mark):

- 1) Summarize what happens at whisking onset time and active-contact onset time for the different cell-classes. Justify your answers with some graphs.

### IV. PERSONAL PROJECT

- 1) Explain in a few lines what is the question you want to address, what is the rationale, and what is your hypothesis?
- 2) Explain briefly what analyses you have done to answer your question and how you have proceeded.
- 3) Present your results with some graphs and explanations.
- 4) Interpret your results, answer your question if possible or explain why you cannot, conclude.