Prof. Dr. Gregor Schöner November 12, 2020

Computational Neuroscience: Neural Dynamics

Exercise 2, hand in by November 19, 2020

Read Chapter 1 "Neural Dynamics" by Gregor Schöner, Hendrik Reimann, and Jonas Lins from the book "Dynamic thinking" (G Schöner, J Spencer and the DFT Research Group, Oxford University Press, 2016) (downloadable under background reading on the course webpage).

Answer the following questions in writing. Use illustrations and/or mathematical formulae, but also provide text in complete sentences!

1. Go through the Einstein argument at the beginning of the chapter. Argue, why without the $-u$-term, the variance of the level of activation increases in time. Formulate in your own words, why the $-u$ term limits that increase. For illustration, you may take Figure 1.8 of the chapter and expand it, annotate it, explain it.

2. Single neuron dynamics. (You can use the-web based simulator at `https://dynamicfieldtheory.org/examples/two_neurons.html` to try out ideas for this).

   (a) Around Figure 1.12, explain how input (a "stimulus") is formally represented in neural dynamics. After a stimulus is applied, how does the activation evolve in time? (Link back to the math you did on exercise 1.1).

   (b) Discuss and illustrate what happens when an input/stimulus is removed again.

   (c) Vary the temporal length of presentation of a stimulus and think through and illustrate what will happen to neural activation. Is there a minimum length of presentation needed to get any positive activation?

3. Perform Exercise 2 a and b of the Chapter with the web-based simulator. Report the parameter values you chose, how you changed parameters to perform the demonstrations, and describe in a paragraph what you observed.

4. Perform Exerice 3 a and b of the Chapter in the same way and report in the same way.