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Essay exercise (worth 3 exercise sheets), due January 7, 2016

In response to each question, write a self-contained text that can be read without having read the question. Make sure you deliver to the reader all information necessary to appreciate the point you are making. Take the reader step by step through your argument. Use illustrations that you label and explain so that they can be understood without going back to the source. Finish each point with a short conclusion.

Do not quote literally from sources, and indicate the source of illustrations.

A typical volume of the essay is about 10 pages, but the size varies with how concise you are. Given the same contents, shorter is better.

If several of you collaborate, each must deliver his or her own text. Identical formulation of pieces of the essay is considered fraudulous.

Read the Chapter 1 "Neural Dynamics" by Gregor Schöner, Hendrik Reimann, and Jonas Lins. (Top entry in list of downloadable items on course webpage).

1. Around Figure 1.12 explain how input (a "stimulus") is formally represented in neural dynamics. Describe how presenting a stimulus to the sensory surface affects the temporal evolution of neural activation. Use your own words and develop your own illustrations! Also discuss and illustrate what happens when an input/stimulus is removed again. Vary the length of presentation of a stimulus and think through and illustrate what will happen then to neural activation. Is there a minimum length of presentation needed to get any positive activation?

2. Write down the neural dynamics of the forward network in Figure 1.2. The downward arrows are excitatory couplings, so that the sigmoided activation of the activation variable from which the arrow starts shows up as a positive additive contribution to the dynamics of the activation variable at which the arrow ends. Weight factors (connective strengths) multiply each input. Assume that weights are chosen such that activation variable 4 goes above zero only if both its inputs activation variables are above threshold (sigmoid saturated). Assume the same for activation variable 5 and 6. Under those conditions, describe and illustrate the output of the network in response to a set of input patters s_1, s_2, s_3 that count from 0 to 7 in binary representation.

3. Based on what you learn about inhibitory coupling among activation variables around Figure 1.19, make the same kind of thought experiment for this two-neuron network. That is, describe the stable activation patterns that are possible in response to the set of 4 input patterns in which inputs s_1 and s_2 take on values of 0 or 1. Assume that in this case, input is strong enough to push an activation variable above threshold if there is no inhibition from the other neuron, but not,

if there is inhibition from the other neuron. You will need to step through 4 cases of initial conditions for the two neurons, in which either neuron can be either below or above threshold before the stimulus is applied. You could use tables or other ways of illustrating this (e.g., you can use the four quadrants of a two-dimensional coordinate frame that spans activations u_1 and u_2).

4. Write down in one paragraph at least one point that you now understood better than in the lectures.

5. Formulate at least one question you have about the Chapter. Can be a question of clarification, of generalization, of criticism.