Exercise 5, November 26, 2015, to be handed in December 3.

This exercise consolidates the tutorial on neurophysics by asking you to read the Box 1.1 in Chapter 1 of the text book "Dynamic Thinking". This chapter is on the course webpage (top of the list of downloads). Answer the following questions by short texts, supported by drawing where appropriate, based on information in that Box. You may also need to look up some issues in the text books or online resources cited in the lecture slides.

1. Membrane potential: In the lecture, the explanation of how the negative resting potential comes about was not quite correct. I incorrectly stated that the negative chloride ions are highly mobile. Based on the text of the Box and any follow-up reading, give a better description of how the negative membrane potential comes about. (Don't literally copy text from the Box or an online source. Try to formulate this yourself. You will see that this really helps understand).

2. Spikes: In the lecture I explained spikes only in reference to the Hodgkin-Huxley model. The actual mechanism remained a bit obscure. Use the paragraph about spiking in the Box to describe in words, how spikes are triggered. You can use the figure I showed in the lecture that illustrates the time course of the channel parameters, m, n, and h together with the intracellular potential, u, to explain the time course of events in spike generation.

3. Synapes: The Box provides more detail on how different synapses lead to different post-synaptic potentials. Describe three ways in which neurotransmitters may induce postsynaptic potentials.

4. Mean Field Theory: The Box describes how many neurons together may form patterns of population activation, that evolve continuously in time on the time scale of integration at the soma (about 10 ms). Make a schematic plot of five spike trains that change from a frequency of about 5 Hz to 20 Hz through the arrival of an input. The five spike trains are different random samplings of these frequencies. Plot a sixth trajectory that is the local mean in a small time window of the spike rate. Speculate how that rate increases at the onset of the stimulus.