481 Tutorial Sheet 1[1]

14 November 2008

Questions

Exam question on this part of the course will *mostly* consist of derivations and descriptions of the course material. Questions 2 and 3 are also questions that could be asked, though in an exam they would be phrased in a less open-ended way.

1. The Nernst equation was derived under the assumption that the membrane potential was negative and the ion being considered had positive charge. Rederive this result for a negatively charged ion and for the case when E is positive to verify that it applies in all these cases.

2. Consider the effect of a triangular pulse on the integrate and fire neuron. When does this cause a spike?
$$I_e = \begin{cases} At & t \in (0, T) \\ A(2T - t) & t \in (T, 2T) \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

3. Another model of the synaptic conductance has an auxiliary function z and satisfies
$$\begin{aligned} \tau_s \dot{P}_s &= e P_m z - P_s \\ \tau_z \dot{z} &= -z \end{aligned} \tag{2}$$
with the rule that z is set to one whenever a spike arrives. P_m is a constant. Solve this for the response to single spike, both with $\tau_s = \tau_z$ and otherwise. In the $\tau_s = \tau_z$ case consider the maximum value of P_s and how this changes if two spikes arrive one after the other. Speculate on the physiological meaning of z.

[1] Conor Houghton, `houghton@maths.tcd.ie`, see also `http://www.maths.tcd.ie/~houghton/481`