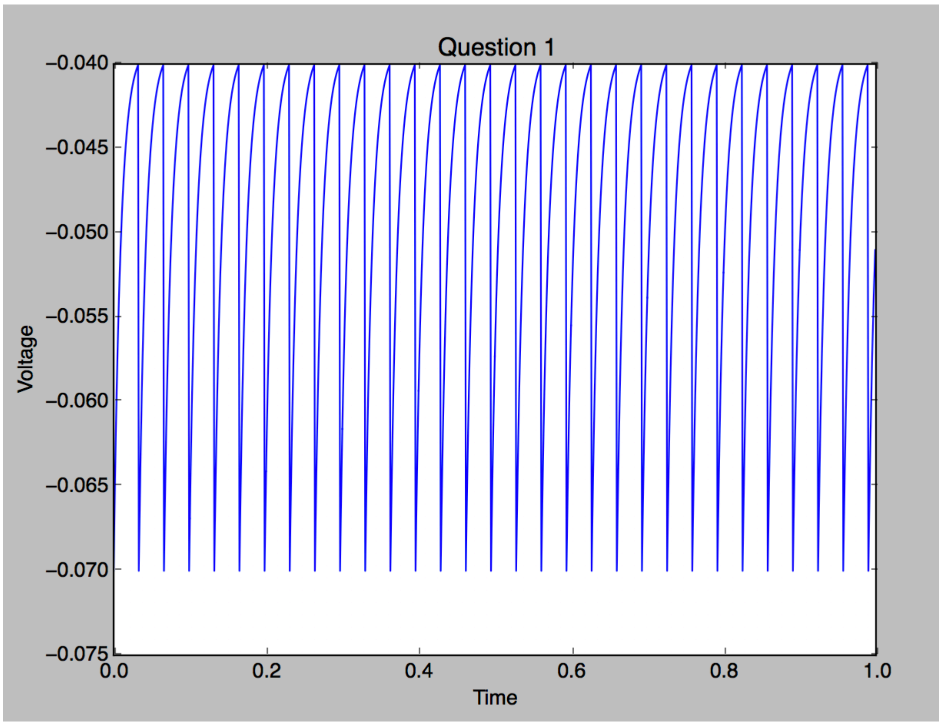
Computational Neuroscience Coursework One : OG14775



1. For all of the following questions the h value with respect to the euler method is 1e-3. Everything else at this point is somewhat self explanatory with respect to the coursework description.

2.

The equations on the right, detail where the voltage stops changing, can be substituted in with the correct values yielding 0 NA. i.e.

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            -70MV + 10M*I >= -40MV
yields:     I > 3 NA
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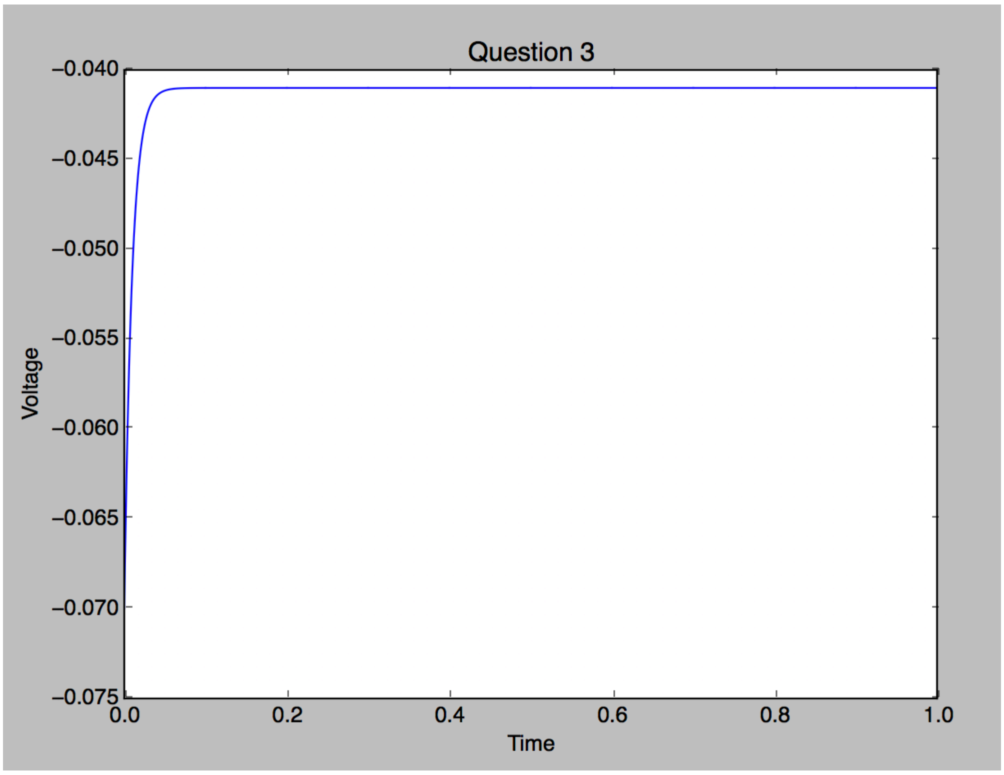
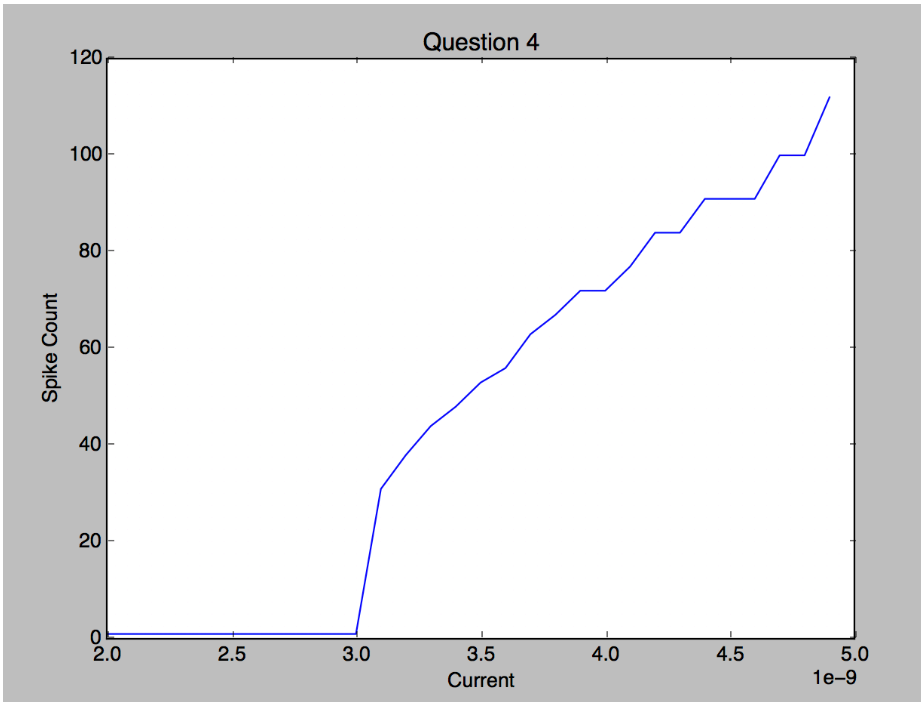
$$\tau_m \frac{dV}{dt} = E_L - V + R_m I_e$$

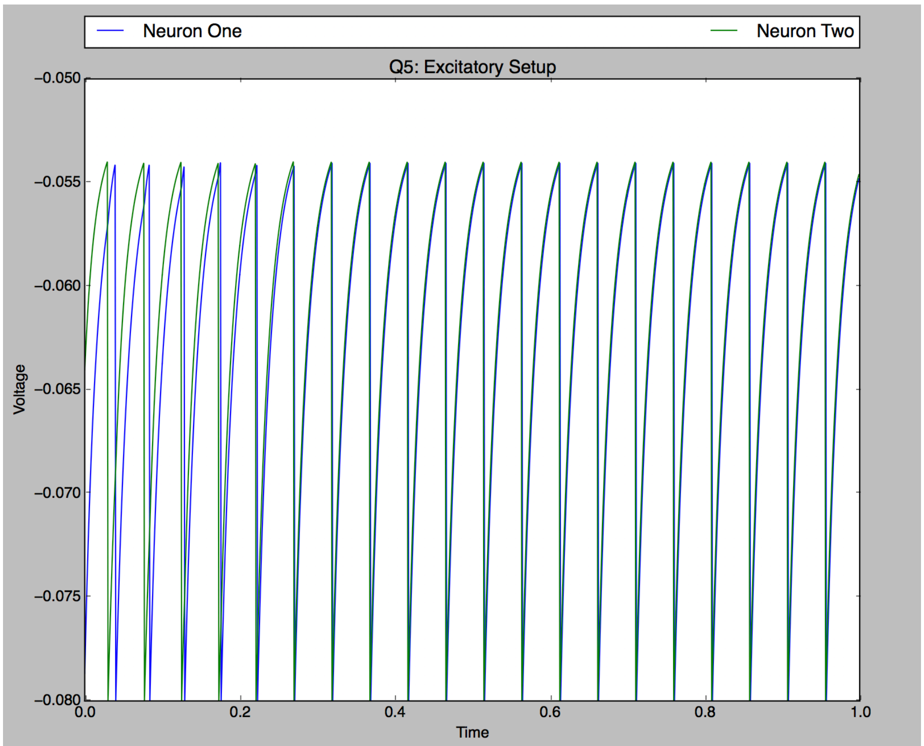
$$\bar{V} = E_L + R_m I_e$$



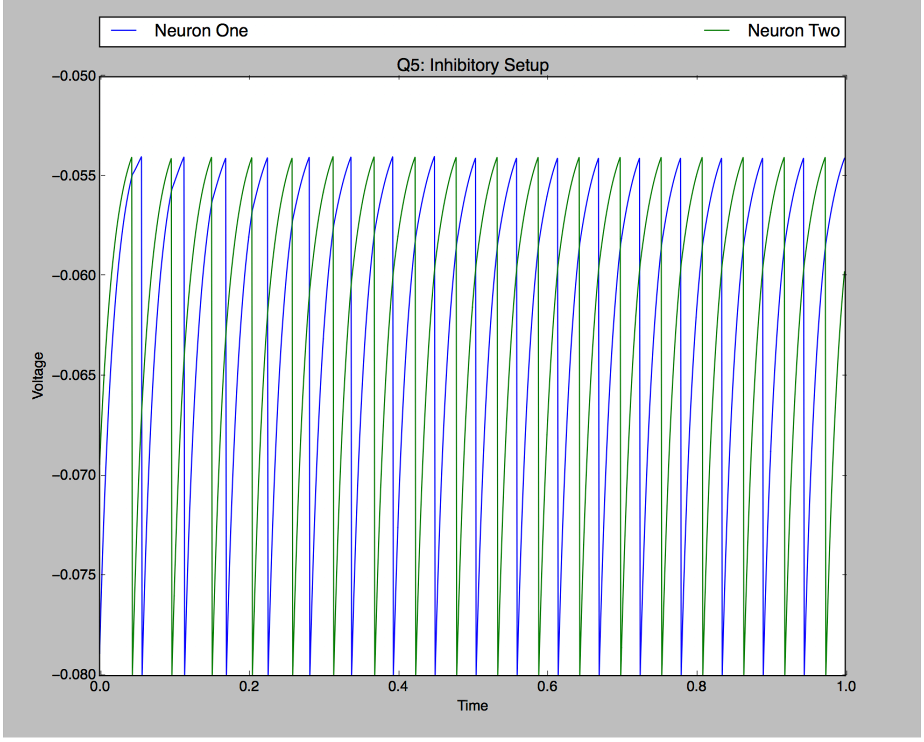
3. On the left, the current is 2.9 NA, which is 0.1 NA less than 3.0 NA, which straddles the boundary of the minimum current required to produce an action potential.



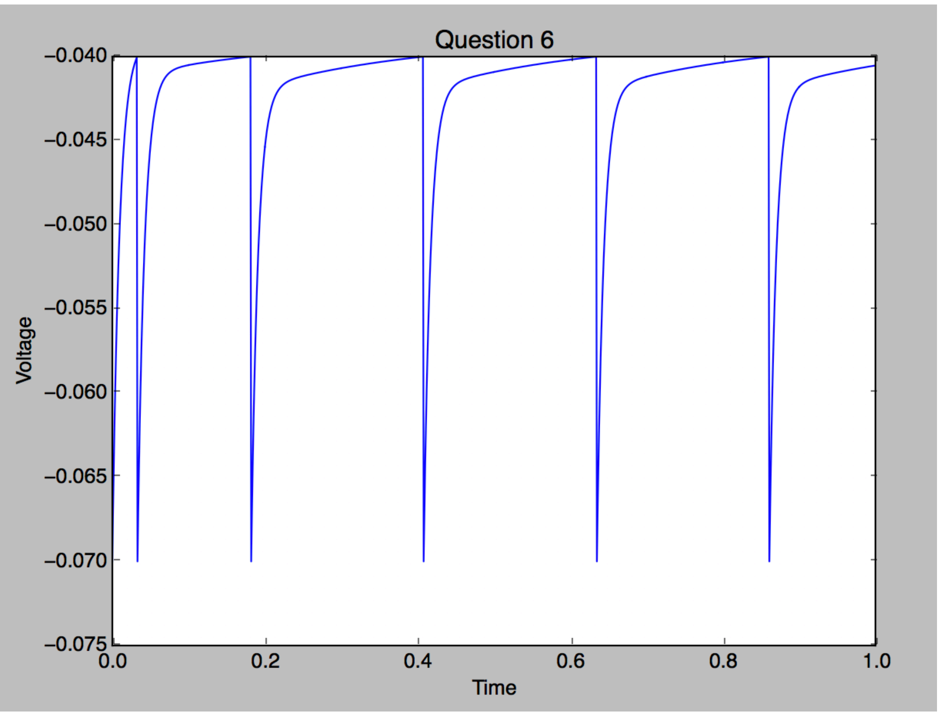
4. As the minimum current is reached, the number of spikes increases at an erratic rate, as the current increases.



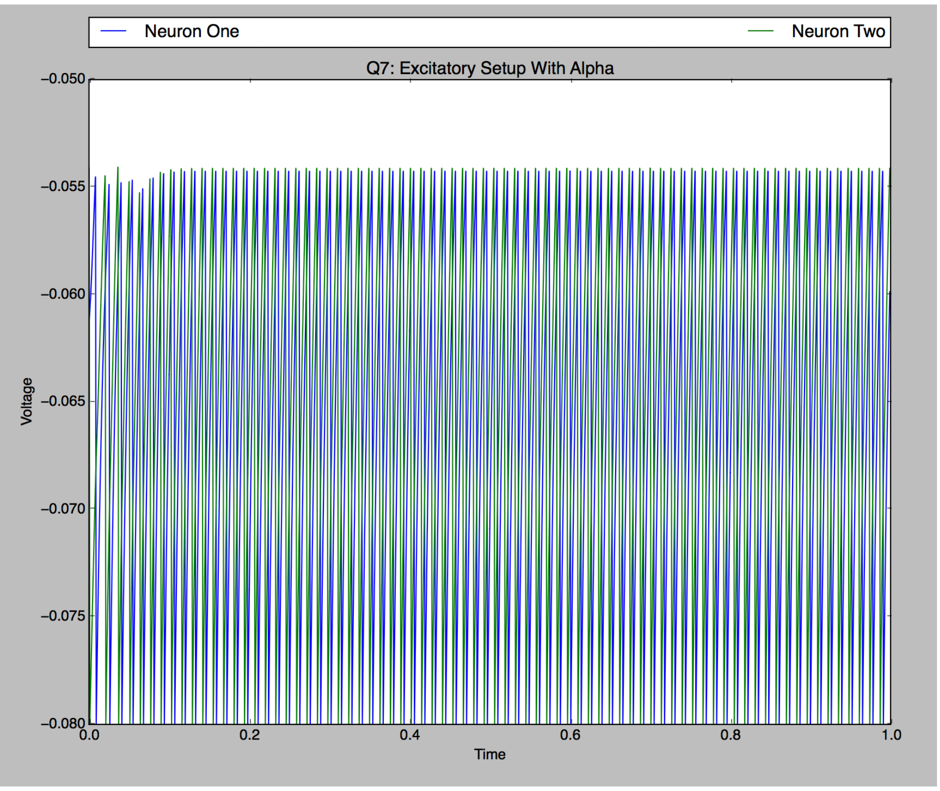
5a. The neurons happened to start antiphase to each other in this instance which demonstrates the excitatory paradigm well. Gradually they move in phase such that as one neuron fires, the other is encouraged to fire at the same time.



5b. This is opposite to the neuron above, with respect to the idea that anti phase firing is encouraged rather than in phase firing. They start more or less in phase and gradually move further apart in phase which demonstrates the inhibitory effect of the firing between both neurons well.



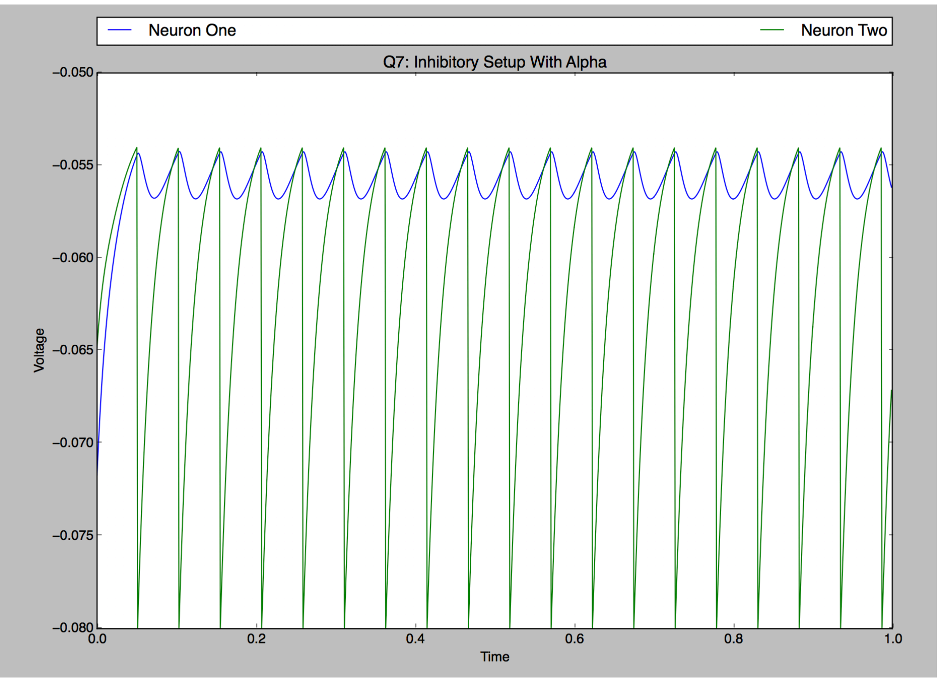
6. As the slow potassium current is increased, the rate of change of voltage after each consecutive firing is decreased as the conductance of the channel which leaks potassium is increased. Here the effect of the conductance increasing is modelled by an increase in the strength of the potassium channel when a spike occurs.



7a. The alpha function is modelled by taking into account previous spikes and their values as they exponentially decay, as the spikes "stack" so to speak. In addition the alpha function has been normalised such that it has a reasonable maximum value that is not infinite.

Alpha function

$$(t/Ts * e^{t/Ts}) * e$$



7b. Here just before the spike of neuron one, it is inhibited by neuron two and does not actually reach its maximum peak value but instead peaks just below it. The long tail and residual values differentiate the alpha function against the simpler version seen in question 5.