

Math 5110/6830
Instructor: Alla Borisjuk
Homework 8.1
Due: November 7

1. Consider a neuron with only one type of ion, X^- , present both inside and outside. The intracellular concentration of X^- is 4 mM, and the extracellular concentration is 120 mM. Let's say that the reversal potential for this ion is V_X .

a) Write an expression for the current I_X , produced by the flow of X^- ions, similar to the ionic currents in the Morris-Lecar model. Assume that its conductance is independent of voltage

b) If we open the membrane channels, associated with these ions, will the current flow make the membrane potential more negative (hyperpolarized) or less negative (depolarized)?

c) Is the reversal potential V_X above or below the typical range of voltage for the membrane at rest (-65 mV)?

d) Write the current-balance equation with I_X as the only ionic current and I_{app} as a parameter.

e) What is the steady-state voltage (the fixed point)? Is it stable or unstable?

f) Is it possible to choose a set of parameters to change the stability of the fixed point?

g) Add another current I_Y to the current-balance equation, such that the conductance is also independent of voltage and the reversal potential is V_Y . What is the new steady-state voltage when $I_{app} = 0$?