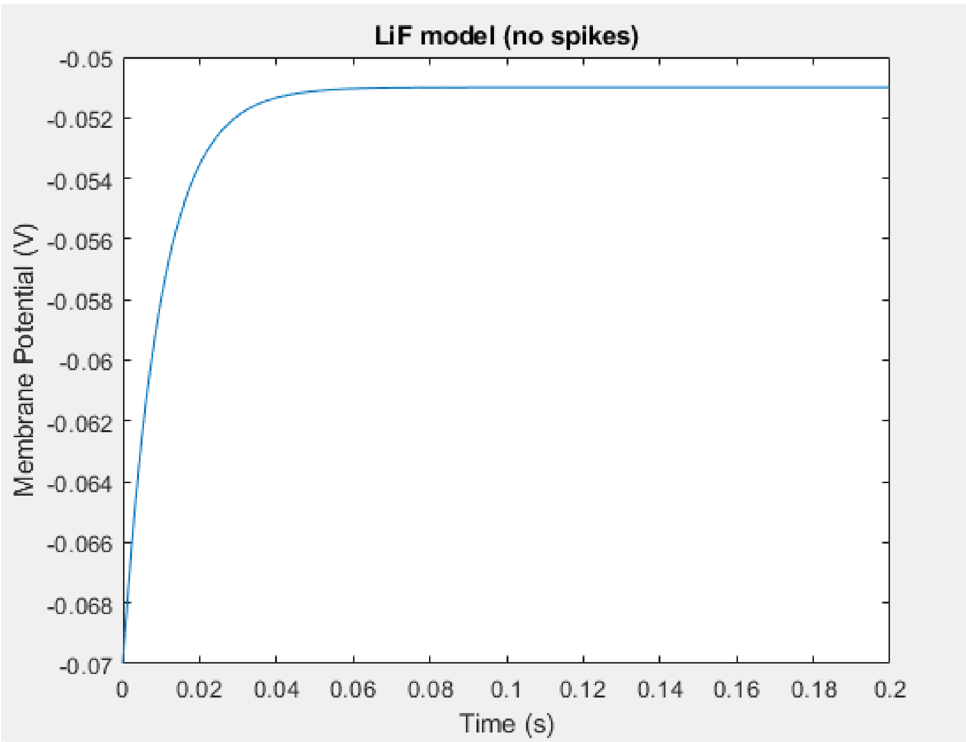
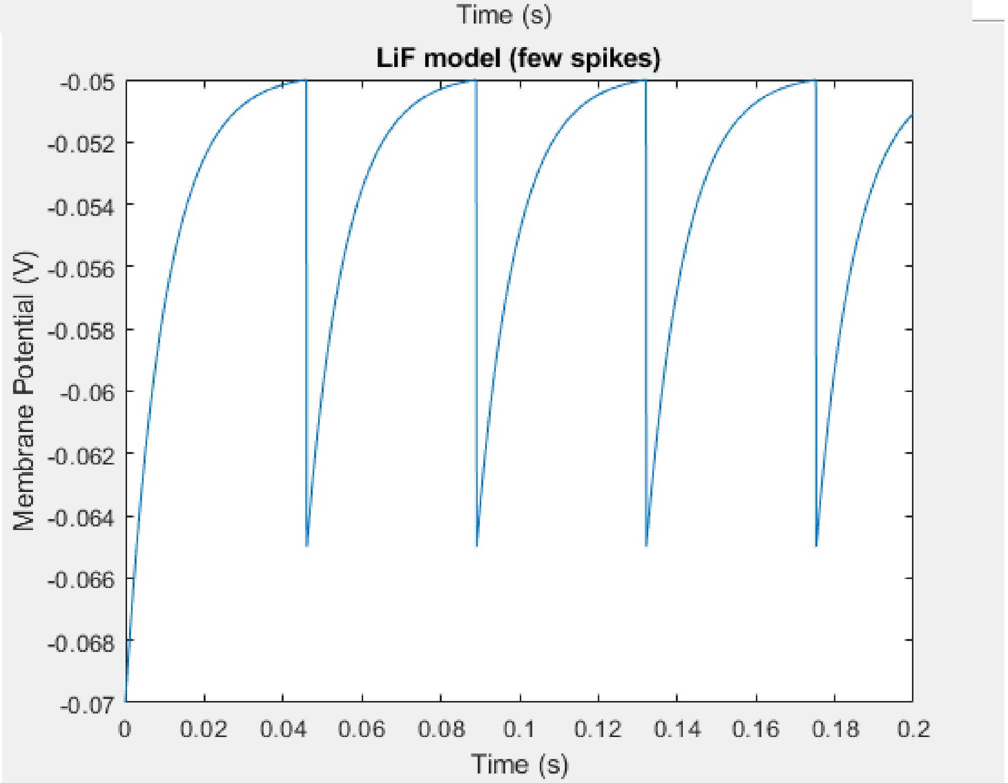
Tutorial 2.1 – Homework 1

Connor Zawacki

1b.)

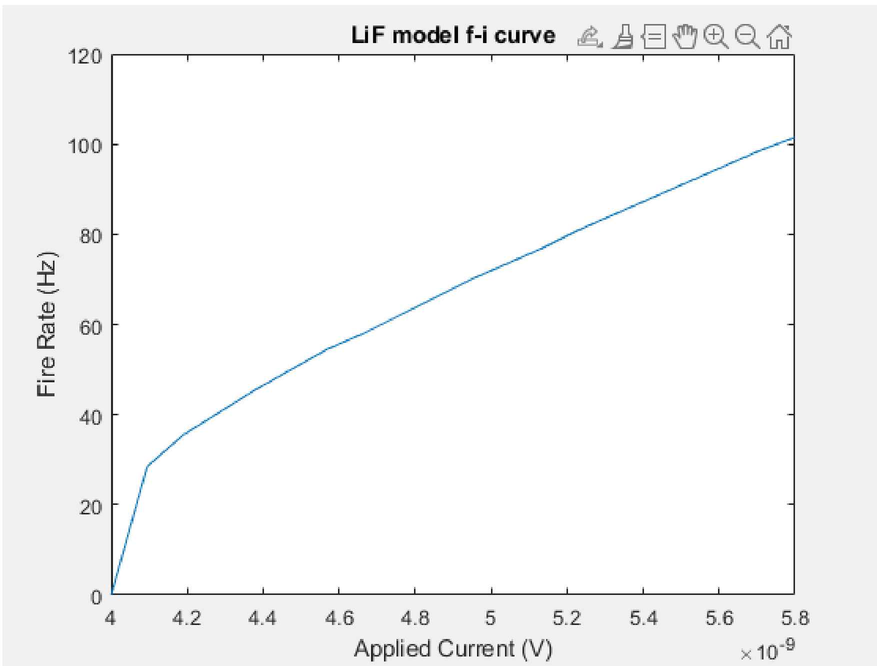




Q: What is the minimum applied current needed for a neuron to produce spikes?

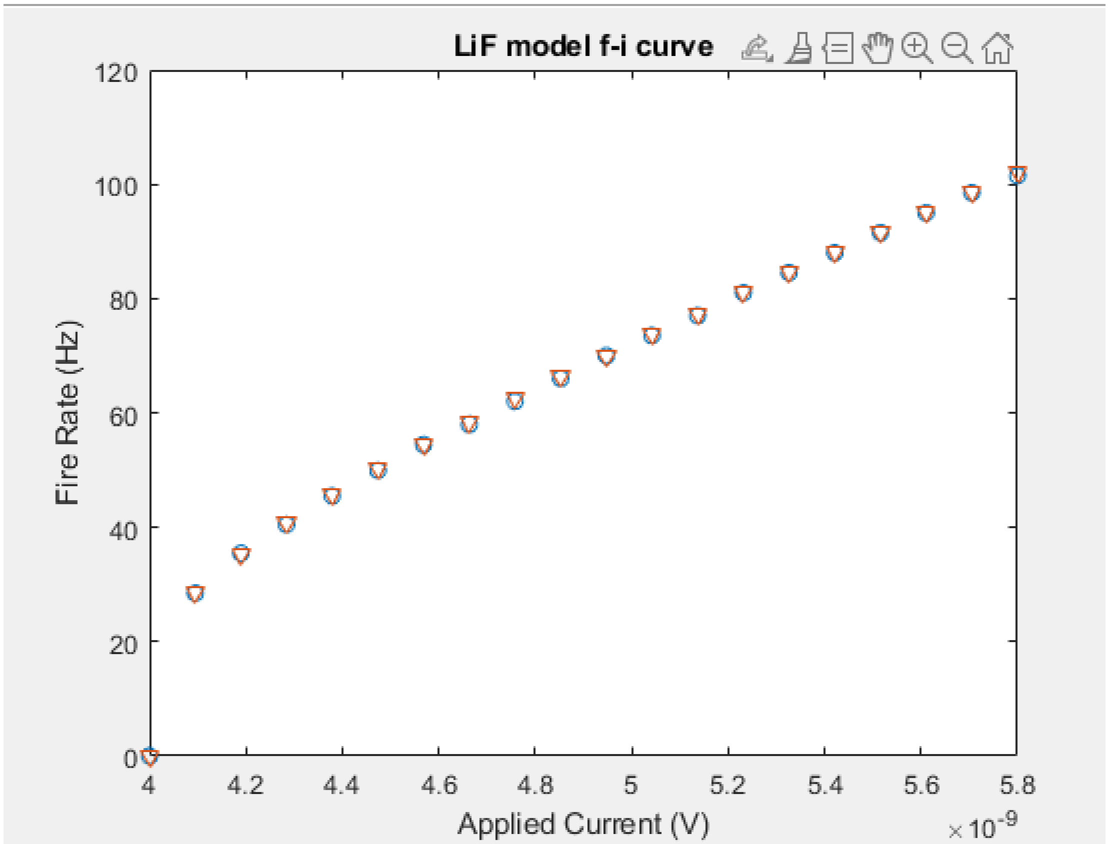
A: min applied current = conductance * (difference between threshold potential and leak potential)
Ith = (1/Rm) * (Vth - EL) = 4*10^-9

1c.)



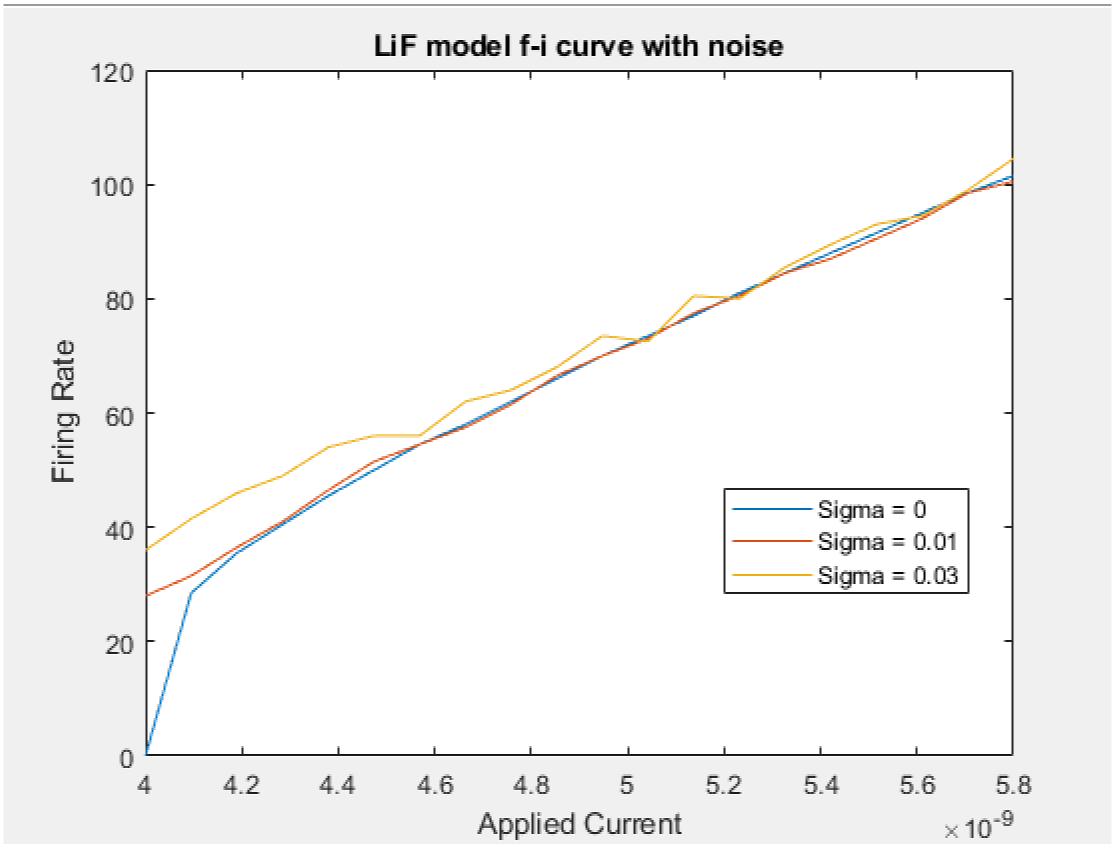
LiF model f-i curve
Fire Rate (Hz)
Applied Current (V)
× 10^-9
120
100
80
60
40
20
0
4
4.2
4.4
4.6
4.8
5
5.2
5.4
5.6
5.8

1d.)



NOTE: in the absence of random input, the curves overlap heavily and are essentially identical.

2a+b.)



Q: Explain the effect of increasing Sigma_I

A: Increasing Sigma_I increases the standard deviation of the noise term. Explained another way, noise will be more pronounced in the data as Sigma_I is scaled upward, providing erratic and random change to the f-I curve.

2c.)

Q: Test that your code is correct by repeating a simulation with your time-step, dt, a factor of ten smaller. Are the results very different?

A: When visualized graphically, the Vm vs time figures appear the same, and the most basic LIF model only appears to have been "smoothened". This makes sense as there is more data points so when visualized graphically the plot will look closer to a continuous function.

I however did notice some mild difference when it came to the noise simulations. It appeared as if the impact of noise was actually more pronounced when visualized graphically. This may just be confirmation bias or an artifact of the fact that I haven't viewed statistically significant trails, however. Considering the sqrt(dt) term in the random noise equation, I would not have expected to see this difference. However, with effectively 10 times the amount of data points, I suppose one could say that there is more of a chance for noise to randomly impact Vm significantly. Such a statement wouldn’t really be mathematically sound however, considering that the equation's mean should approach 0 given an incredibly large amount of data points.