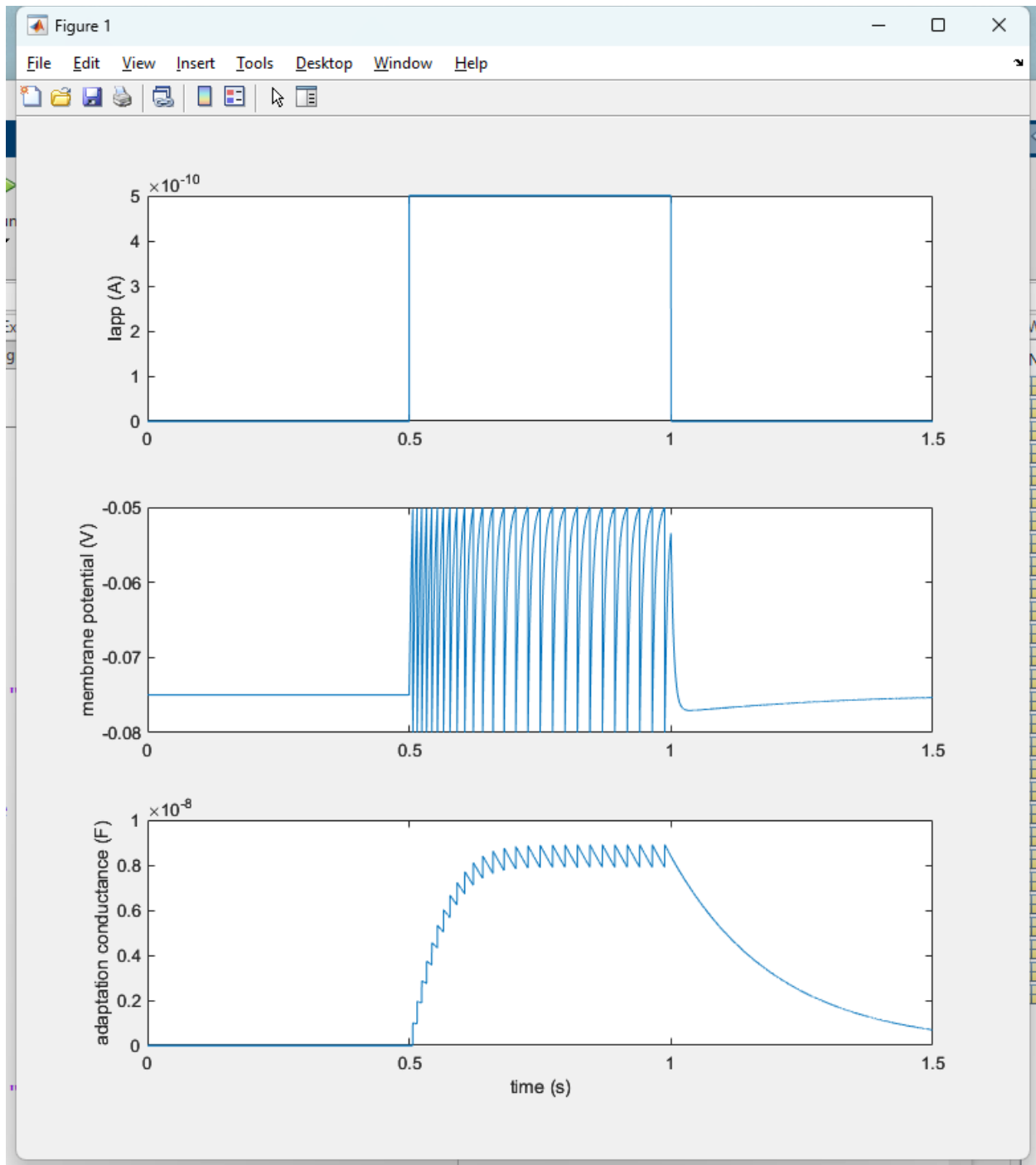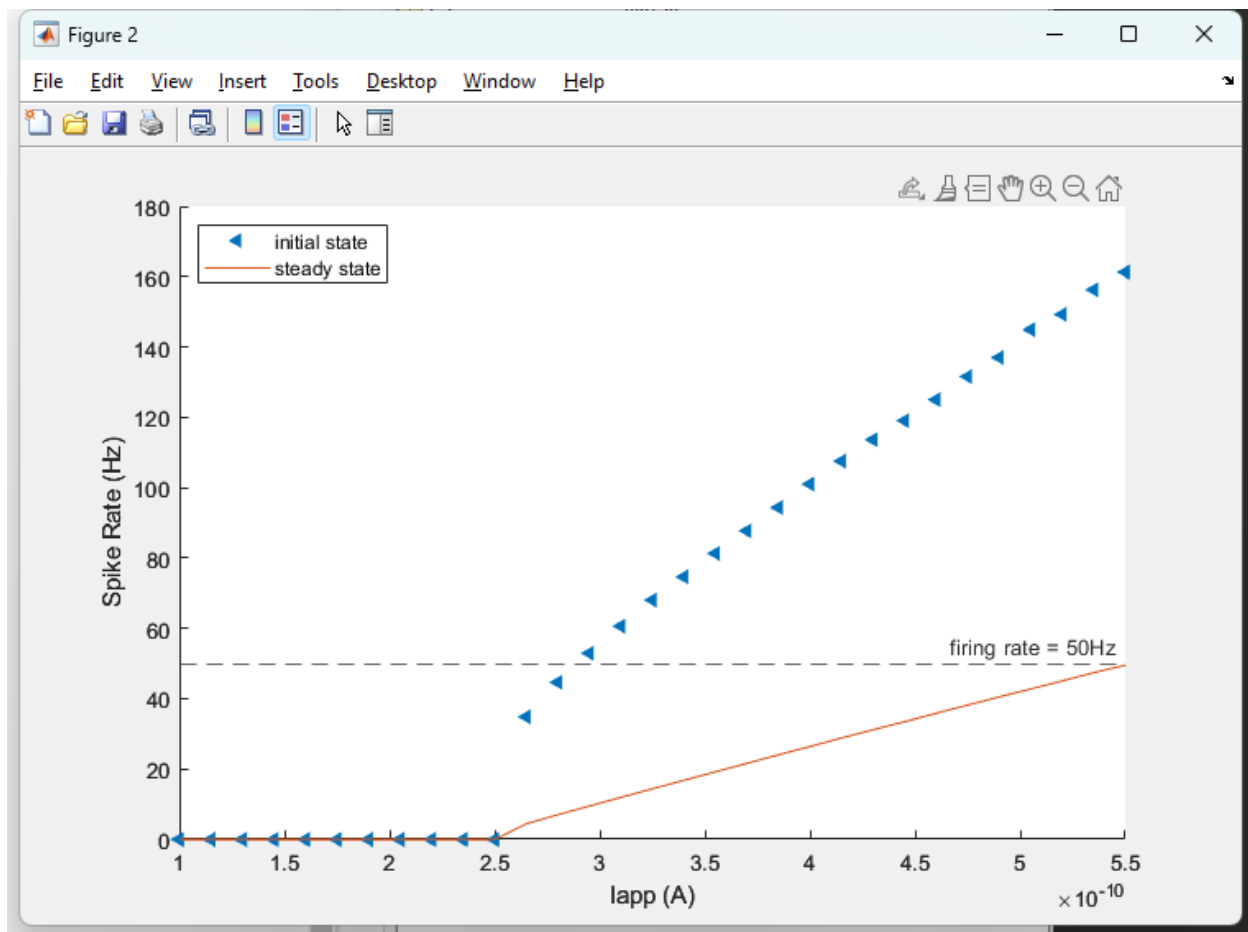Tutorial 2.3 by Clark Xu.

Code file is `ExponentialLIF.m`

To view plots for questions, edit variable `question_number` to 1, 2, 3, or 4, matching to question 1(a), 1(b), 2(a), and 2(b) respectively.

Tutorial question 1(a):

Tutorial question 1(b)

Comments:

Figure in question 1(a) shows that the spike appears more frequently when there's a steady applied current above threshold that applied on the neuron. The adaptive conductance grows exponentially and remained in a relative steady state at the end of pulse. The spike rate also tends to be stable at the end of the pulse in the graph.

From figures in question 1(b), we can observe that the firing rate at steady state increasing "almost" linearly as the applied current increases within the 0.25 to 0.55nA range. Within this applied current range, the spike rate for steady states varied from 0 to 50 Hz. The firing rate for neuron's initial state shows a similar trend but has a faster growing rate. Noted that there's a large increase in firing rate when applied current increase from threshold (0.25nA) to 0.27nA for both initial and steady state. they both show the behavior of type-II neuron.

0.25nA is the threshold for firing for both states. When the applied current is lower than 0.25nA, both firing rates for initial and steady states are "zero" (i.e. not firing in the 5-second simulation time).

Question 2(a)

Question 2(b)

Figure 2
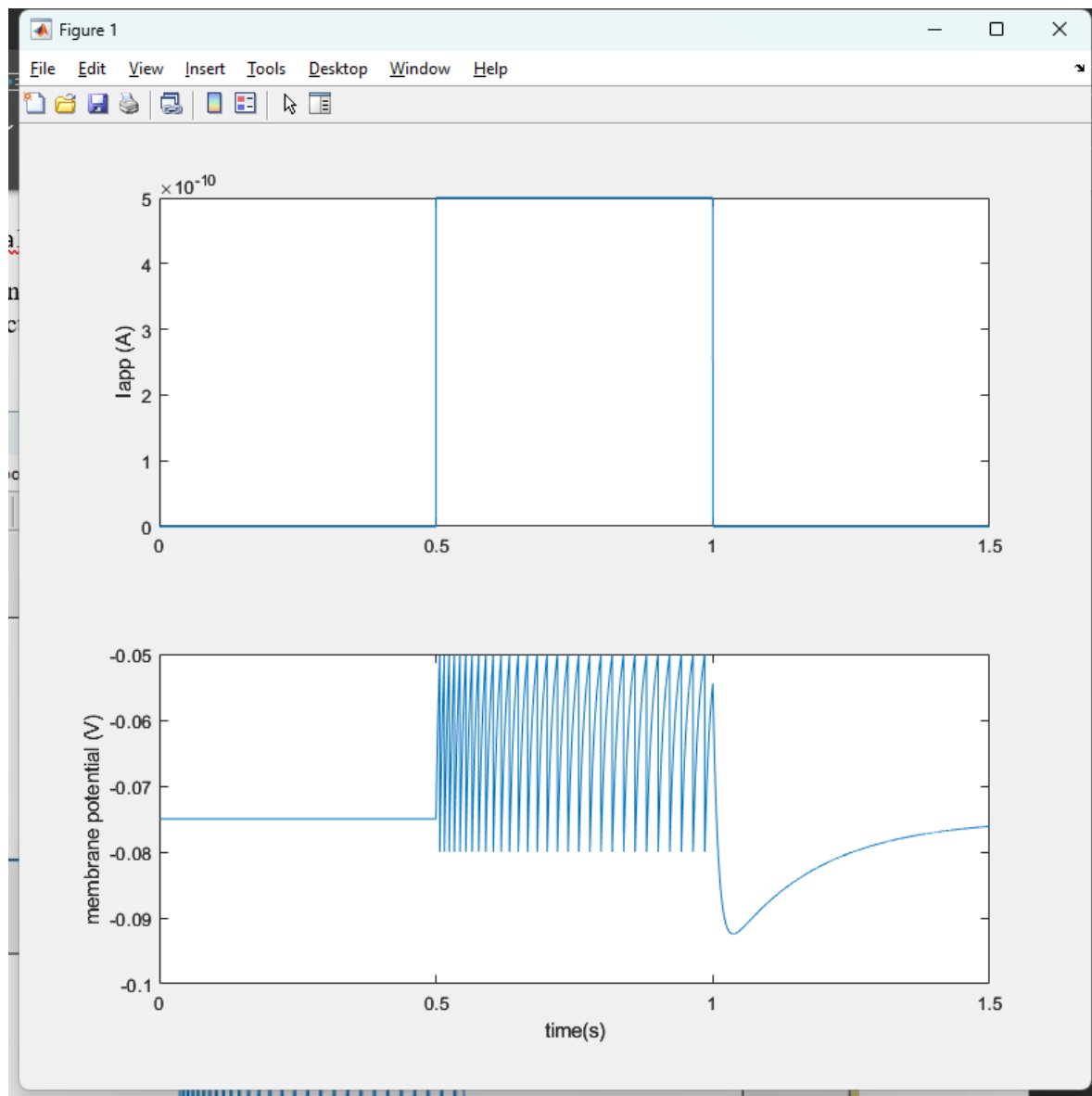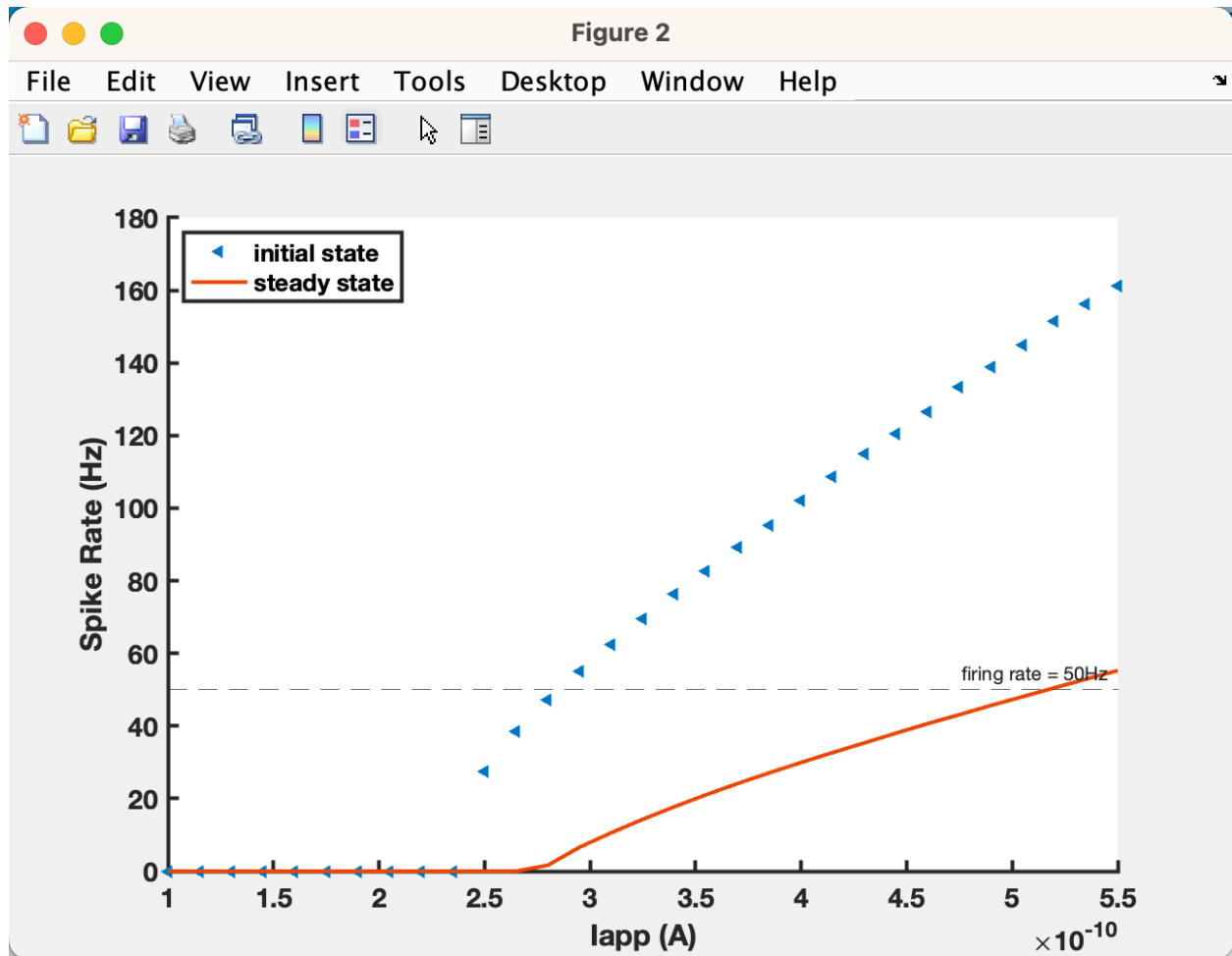
AELIF model gives results that are similar to the ones in LIF model. However, what's different from LIF model is that initial and steady states are not sharing a same applied current threshold. In AELIF model, when the applied current is above the 0.25nA model, the model could fire for a short amount of time, but the spikes do not last until the end of simulation (lasting for only a few spikes and stay in steady state for the rest of simulation). In contrast, in the LIF model, the spiking would last for the whole simulation and reach their steady states if above the threshold. When the applied current exceeds the 0.25nA threshold, the firing rate of initial states is rising, while the steady states still remain zero until 0.27nA in applied current. In AELIF model, the firing rate for initial states is the same as LIF, showing the behavior if type-II, while the firing rate for steady states looks more "linear" compared to the behavior in LIF model. Otherwise, the plots for LIF and AELIF model are almost the same.