2.2 Refractory Period after spiking

(Video 2.2) In a real neuron, there usually exists a refractory period after a spike, a result of Na^+ channel inactivation followed by an outward K^+ flux from the neuron, leading to temporary hyperpolarization. The equation for SRA that you have already implemented can also be used to model a refractory period, simply by using different parameters. To do so we decrease the value for τ_{SRA}, increase the value for Δg_{SRA} and rename them τ_{RP} and Δg_{RP} respectively. Also, we keep the reversal potential E_{k} and rename it E_{RP}. For instance, try $\tau_{\mathrm{RP}} = 50$ ms and $\Delta g_{\mathrm{RP}} = 0.12$. Then replace the step current input by the excitatory and inhibitory synaptic inputs with Poisson spiking, as in Sec. 1.4.

Now verify the response of the neuron and compare it to the neuron in Sec. 1.4 which did not have a refractory period. With a refractory period, spiking of the neuron should be more regular than without. Plot a histogram of the ISIs of the neuron's output spikes, and a histogram of the CVs of the ISIs, as before. Does the distribution of ISIs look different for this neuron compared to Sec. 1.4? Is the CV lower for a neuron with a refractory period?

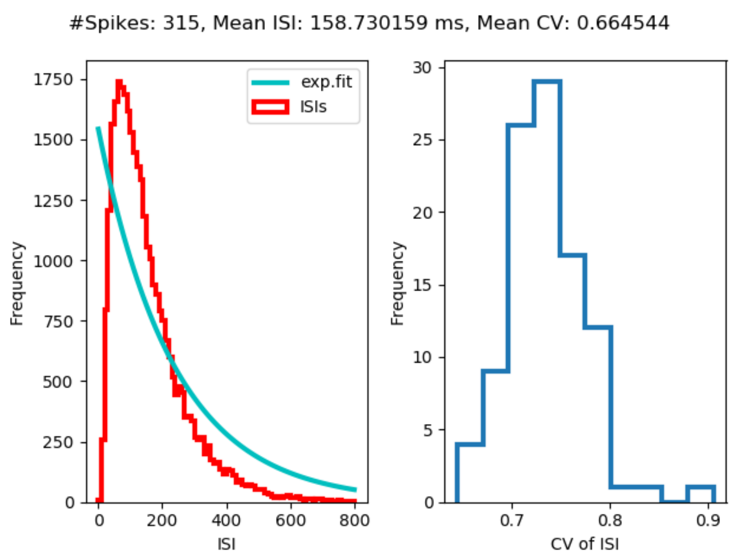

Figure 1: A LIF neuron with a refractory period of 50 ms and Poisson spiking inputs. Left: The distribution of ISIs clearly deviates from a decaying exponential, showing a lack of very small intervals due to the refractory period. Right: the CV of ISIs is decreased on average, compared to the neuron without the refractory period in Sec. 1.4, indicating that the neuron fires more regularly due to the presence of a refractory period.