Computational Neuroscience: Problem set 4

Matlab code of the Integrate-and-Fire model

Integrate-and-Fire Model

Code an integrate-and-fire model, given by the following equation:

$$\tau_v \frac{dv}{dt} = -v + RI, \tag{1}$$

where the time constant $\tau_v = 10$ms and the resistance $R = 1$. When the neuron crosses a threshold $v_{th} = 10$, the neuron emits a spike and is reset to 0.
Use the Euler method to simulate the neuron model, with a time step of 1ms. For the Euler method, we can re-write the integrate-and-fire model as: $\tau_v \frac{v(t+1)-v(t)}{\Delta t} = -v(t) + RI(t)$, where Δt is the time step. We therefore have: $v(t+1) = v(t) + \frac{\Delta t}{\tau_v}(-v(t) + RI(t))$.

Simulate the neuron for 100ms for different constant currents $I = 9$, $I = 11$, $I = 15$. Plot the voltage across time for the different currents. Comment.