گزارش تمرین اول درس علوم اعصاب محاسباتی سارا رضایی – ۹۸۲۲۲۰۴۳

در این تمرین پیاده سازی سه مدل نورونی :

- Leaky integrate and fire(LIF)
- Adaptive LIF
- Exponential Adaptive LIF

انجام شده است.

هر مدل با ۵ تابع جریان ورودی مختلف از جمله :

- Step-function current
- Constant current
- Linear current
- Sine wave current
- Exponential current

ورودی داده شده است.

نتایج این ورودی ها روی نمودار های membrane potential – time نمایش داده شده و همچنین برای جریان ثابت نمودار I – Frequency نیز رسم شده است.

توابع محاسباتی هر مدل به شرح زیر میباشد :

LIF model

$$\tau * \left(\frac{du}{dt}\right) = -(u(t) - u_{rest}) + RI(t)$$

$$if\ u(t) = Threshold \Rightarrow Fire + Reset\,(u = u\_reset)$$

ALIF model

$$\tau * \left(\frac{du}{dt}\right) = -(u(t) - u_{rest}) - Rw + RI(t)$$

$$\tau_w * \left(\frac{dw}{dt}\right) = a(u - u_{rest}) - w + b.\tau_w \sum \delta(t - t_f)$$

$$if\ u(t) = Threshold \Rightarrow Fire + Reset\,(u = u_{reset})$$

AELIF model

$$\tau.\left(\frac{du}{dt}\right) == -(u(t) - u_{rest}) + \Delta T\ exp\left(\frac{u - \theta_{rh}}{\Delta T}\right) - Rw + R \cdot I(t)$$

$$\tau w.\left(\frac{dw}{dt}\right) = a(u(t) - u_{rest}) - w + b.\tau_w \sum \delta(t - t_f)$$

$$if\ u(t) = Threshold \Rightarrow Fire + Reset\,(u = u_{reset})$$

نتایج مدل ها :

ورودی تمامی مدل ها به شرح زیر میباشد

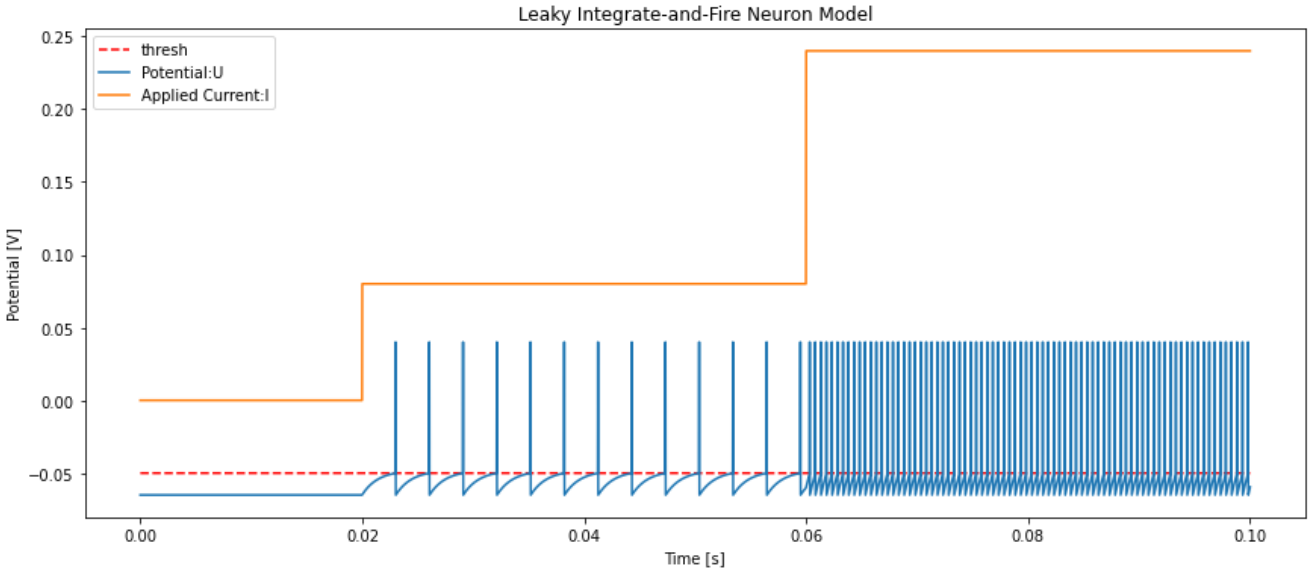
$$I = 0.08\,v$$

$$g_l\,(=\ 1/r) = 4.7$$

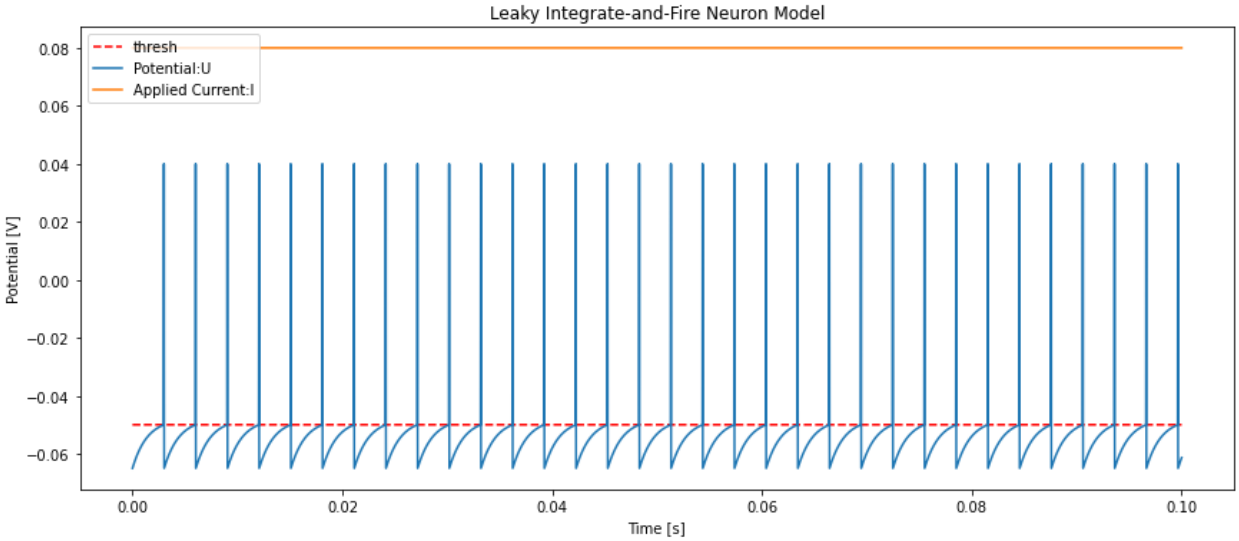
$$C_m(capacitance) = 0.00675$$

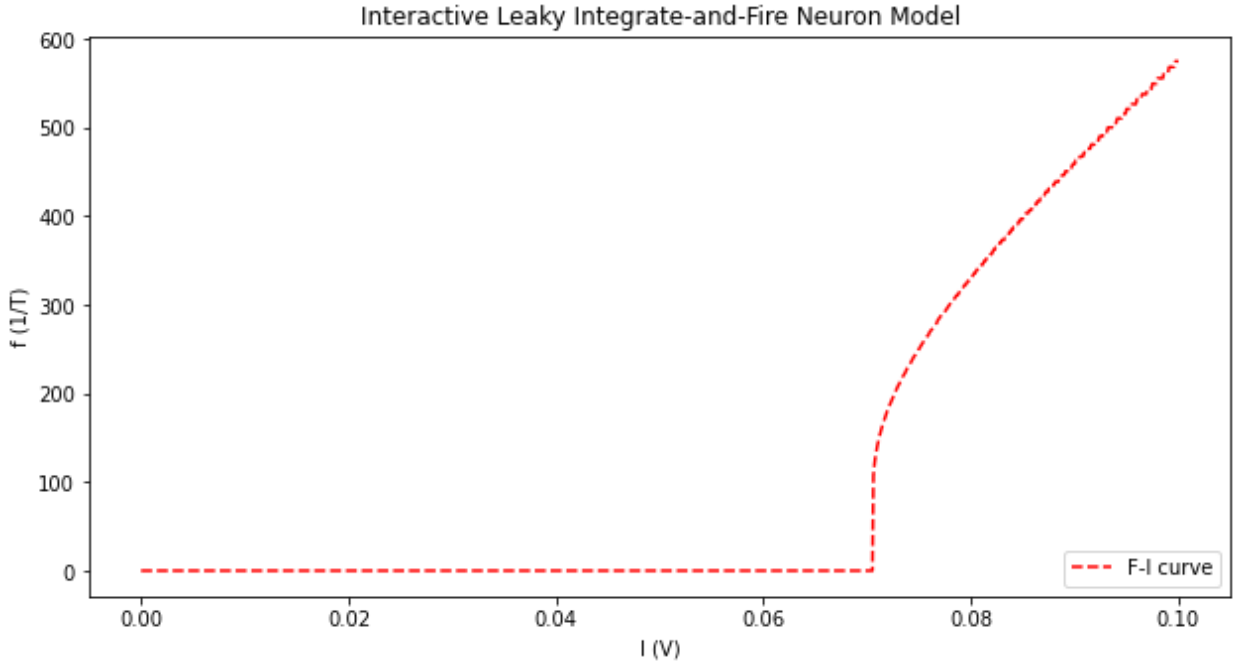
LIF model

- Step-function

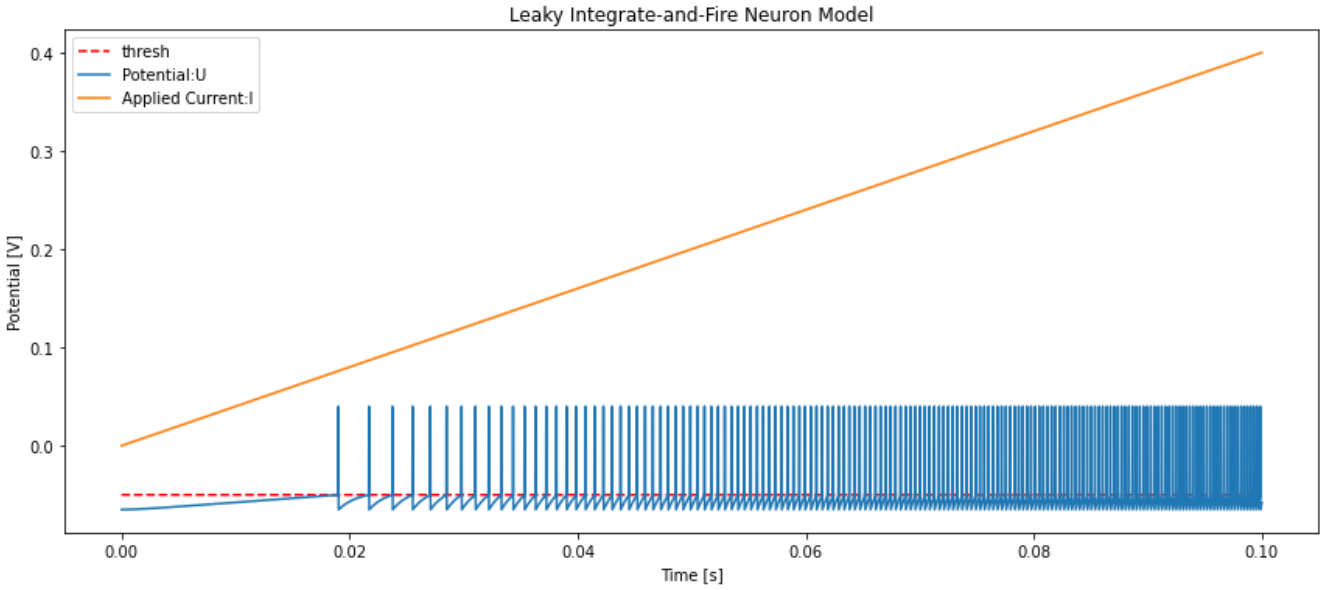


- Constant

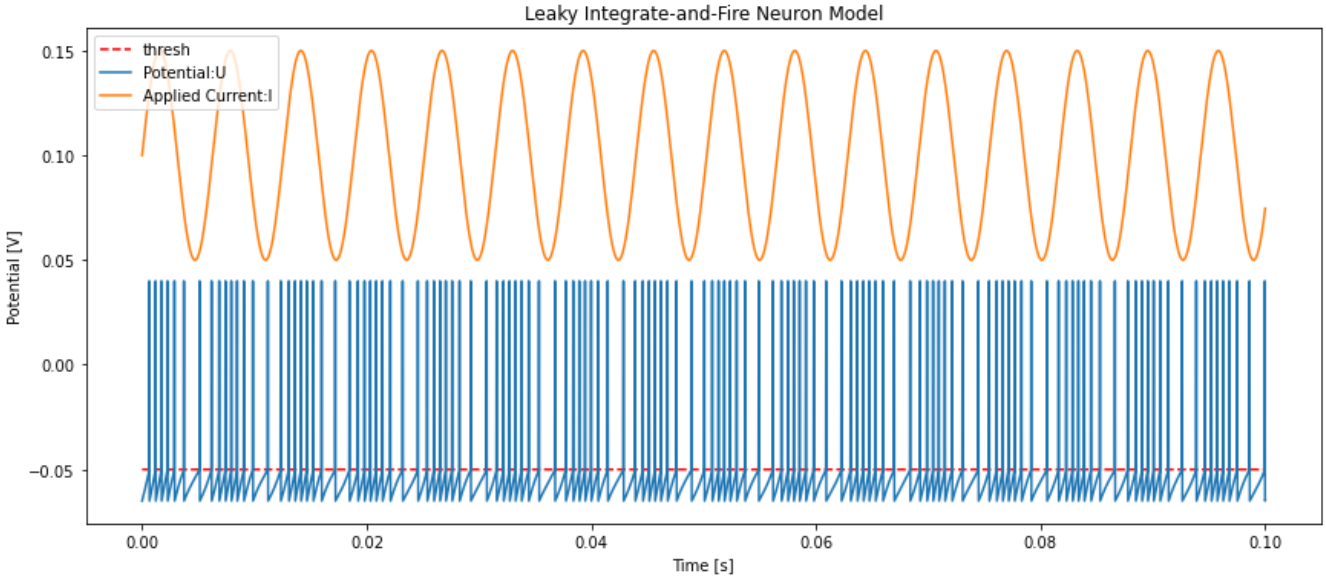

Leaky Integrate-and-Fire Neuron Model
thresh
Potential:U
Applied Current:I
Potential [V]
Time [s]


Interactive Leaky Integrate-and-Fire Neuron Model
f (1/T)
I (V)
F-I curve

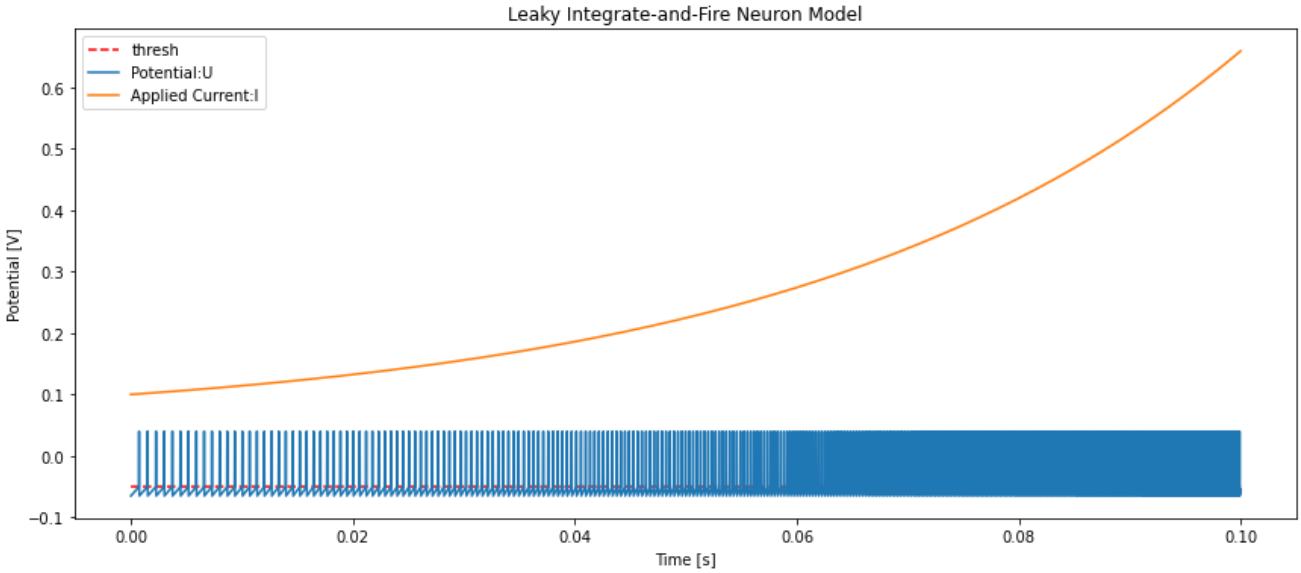
- Linear



- Sine wave

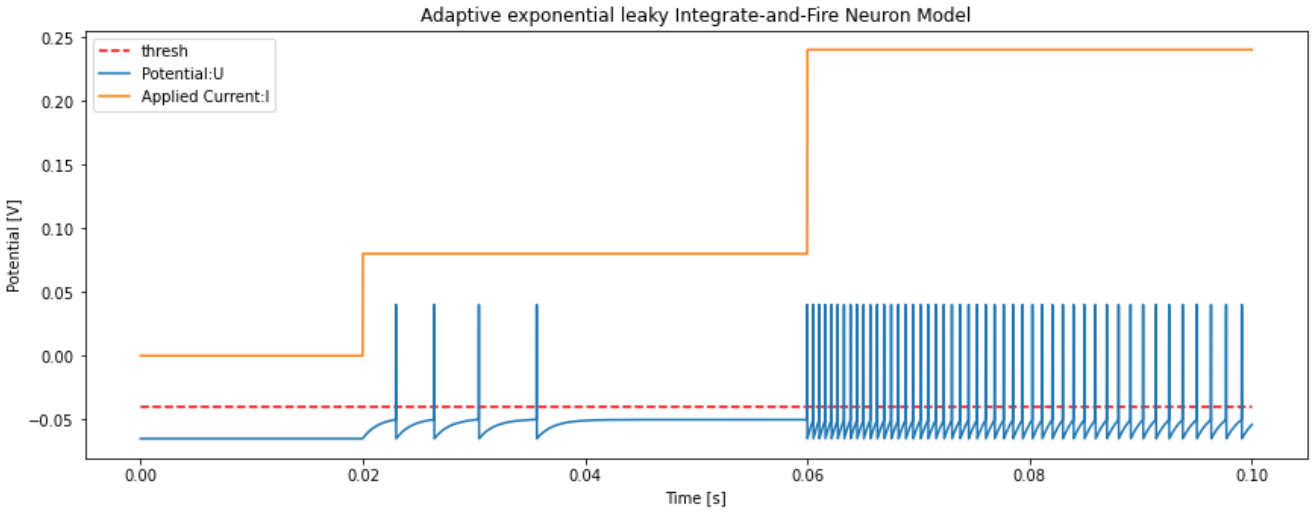


- Exponential

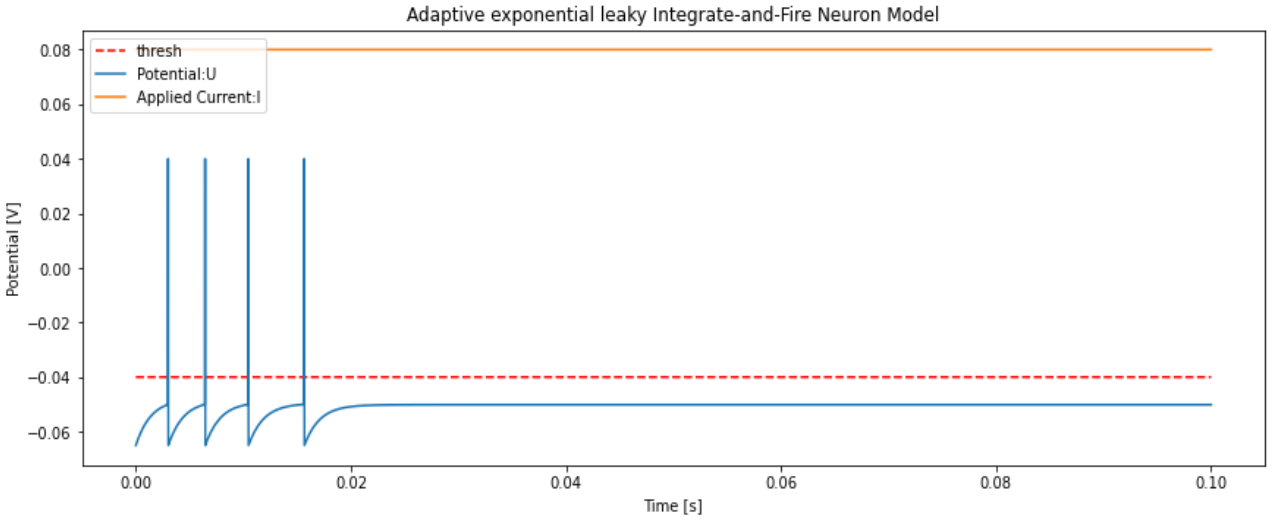


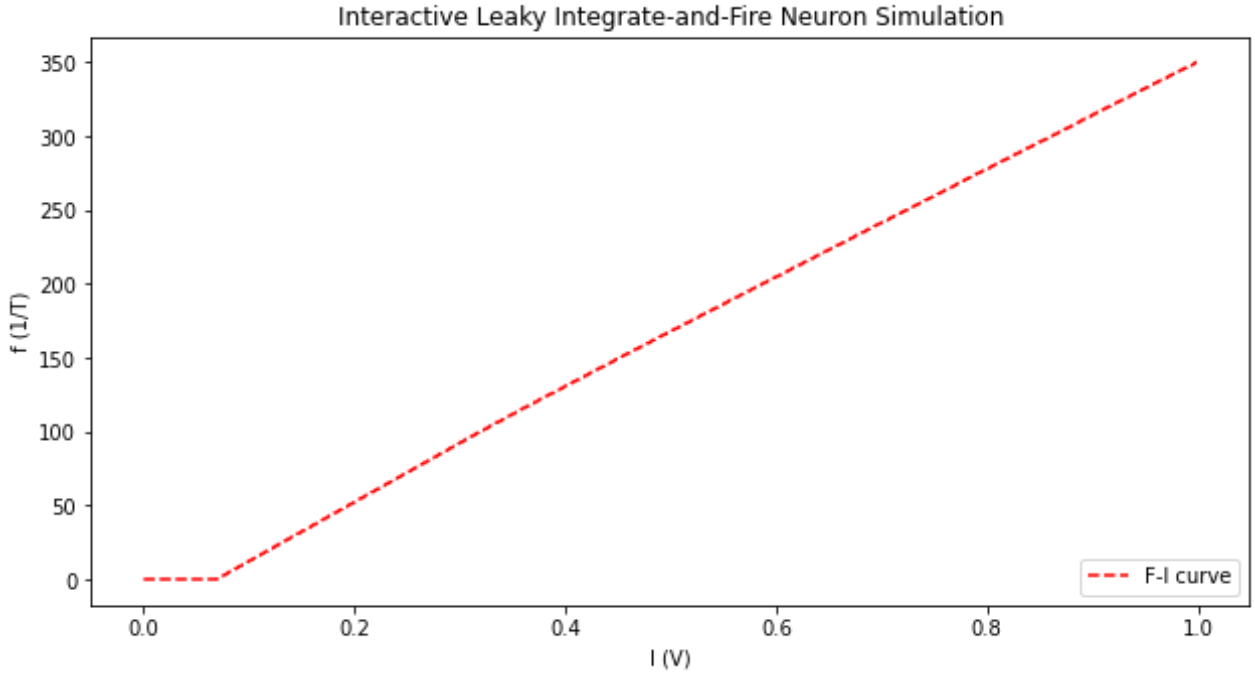
ALIF model

- Step-function

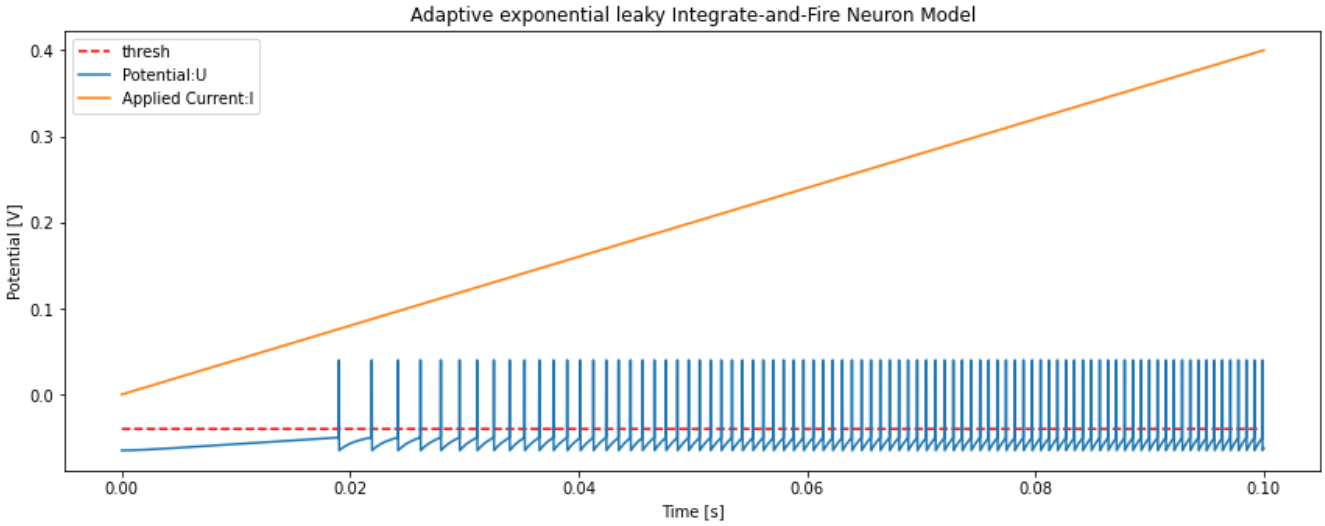


- Constant

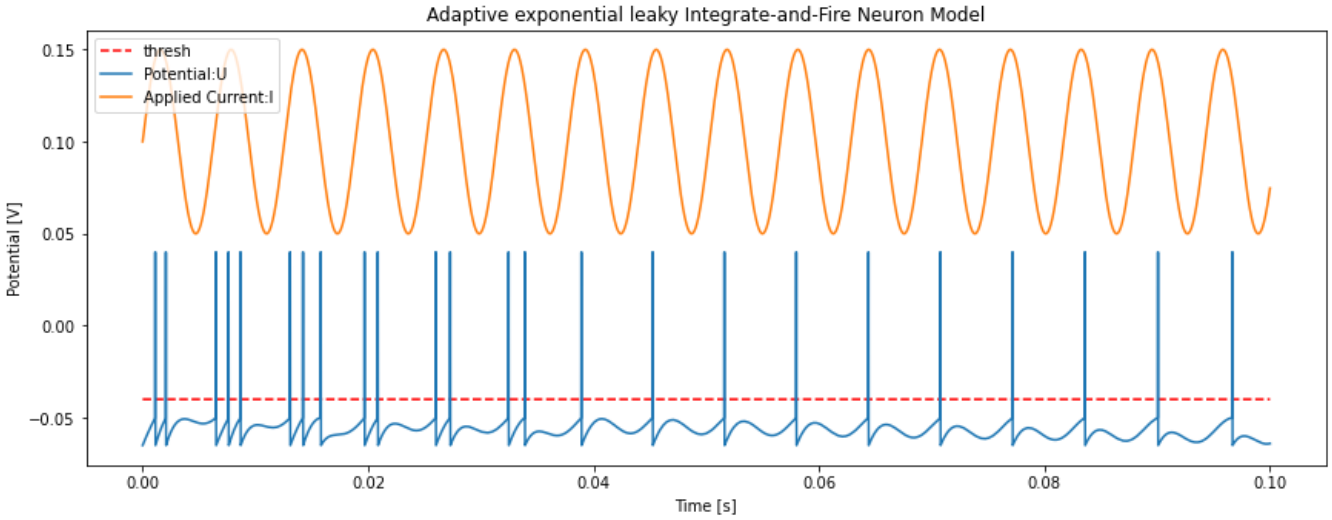

Adaptive exponential leaky Integrate-and-Fire Neuron Model
thresh
Potential:U
Applied Current:I
Potential [V]
Time [s]


Interactive Leaky Integrate-and-Fire Neuron Simulation
f (1/T)
I (V)
F-I curve

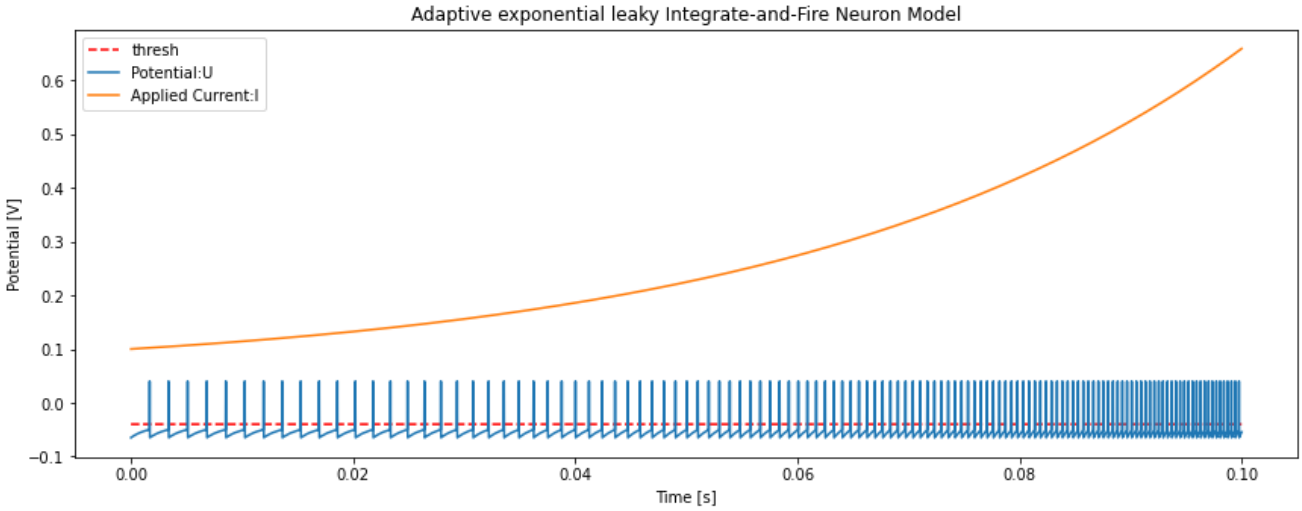
- Linear



- Sine wave

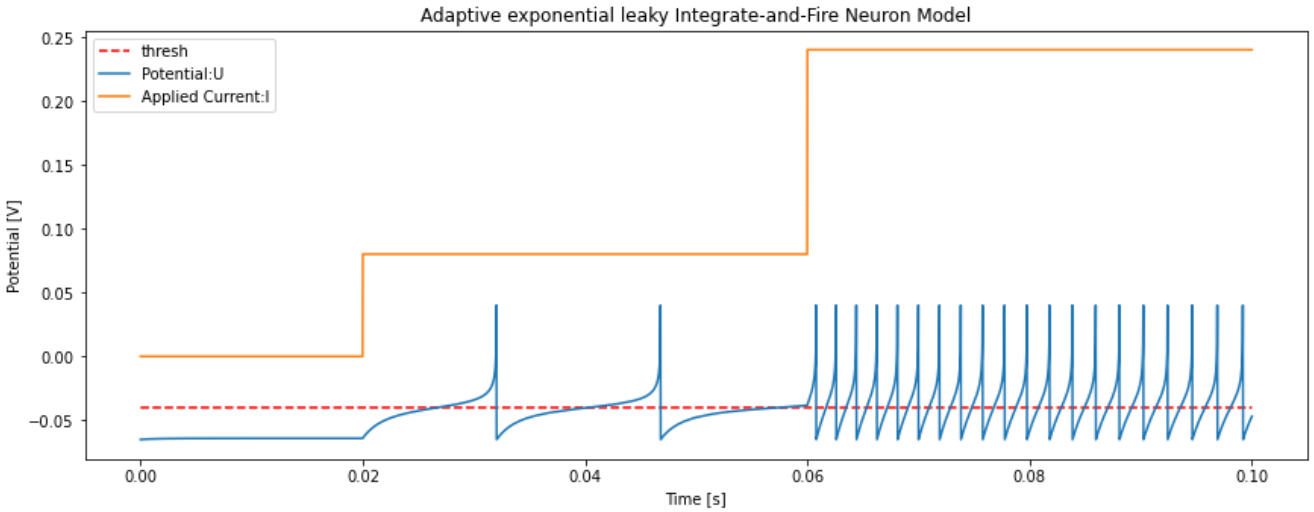


- Exponential

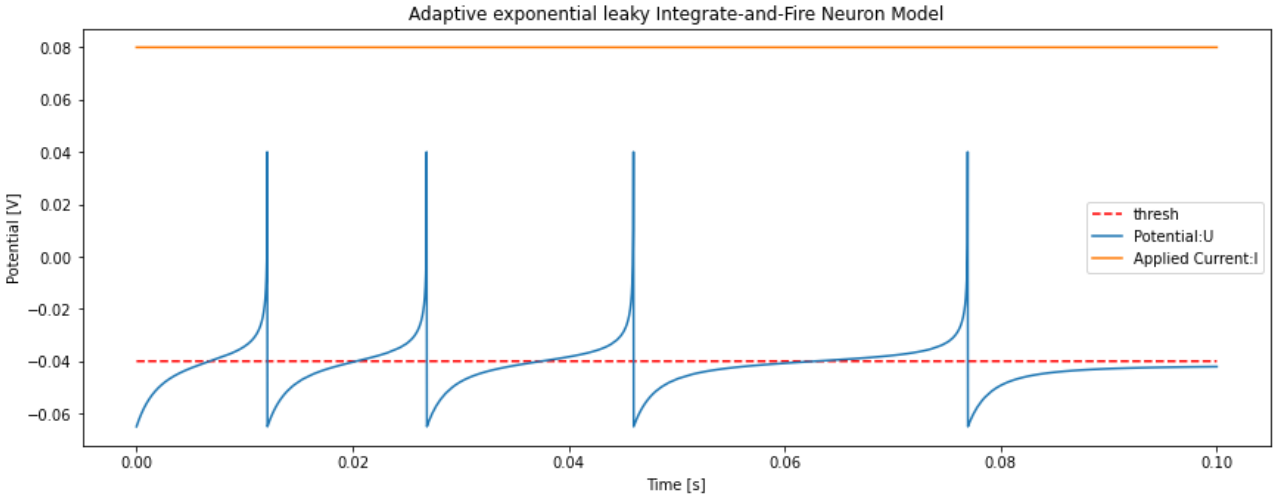


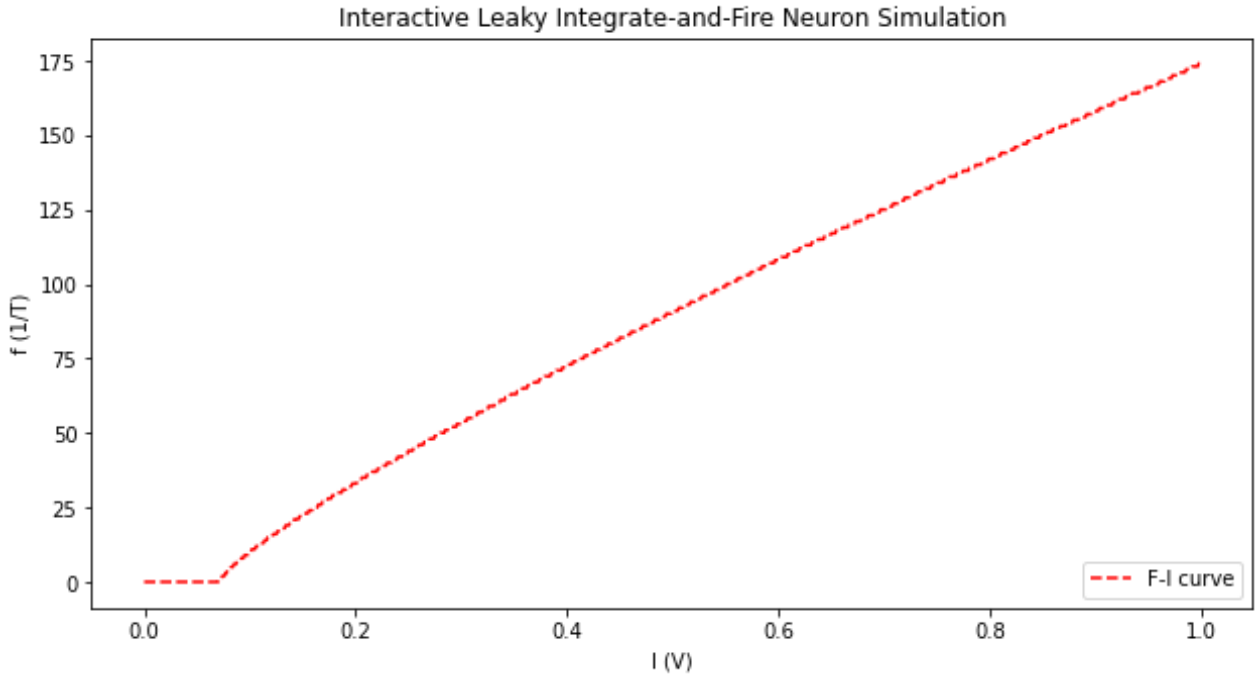
AELIF model

- Step-function



- Constant


Adaptive exponential leaky Integrate-and-Fire Neuron Model
Potential [V]
Time [s]
thresh
Potential:U
Applied Current:I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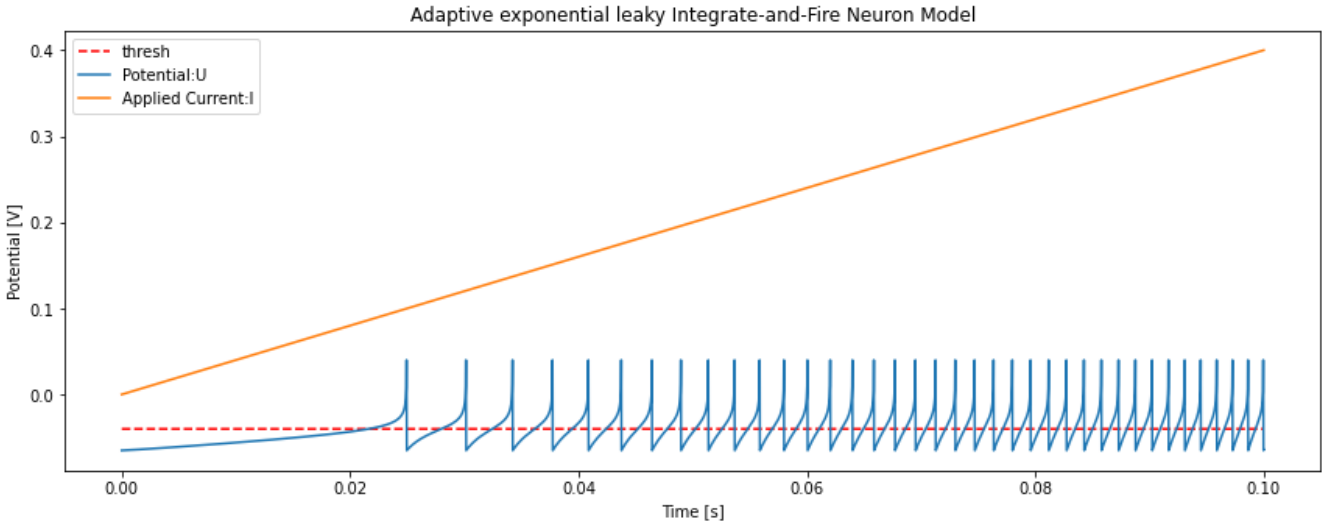
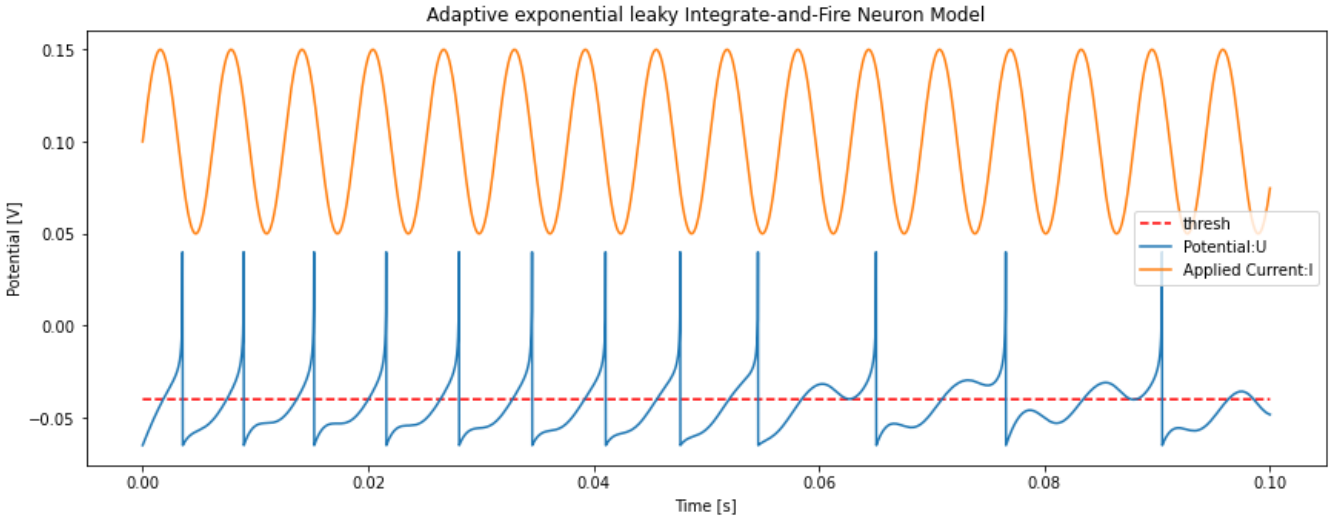
f (1/T)
I (V)
F-I curve

- Linear



- Sine wave



- Exponential