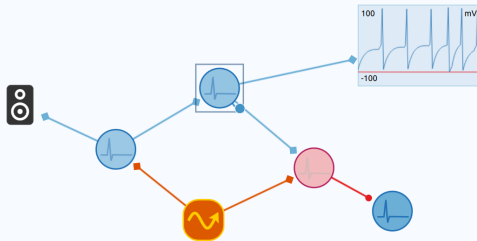


# Neuronify: a new tool for creating simple neural networks

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CINPLA - University of Oslo  
Wednesday 20<sup>th</sup> May, 2015



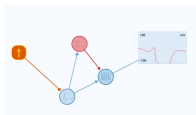
# In this lecture we will introduce Neuronify, a new tool for creating neural networks



Integrate and fire neurons

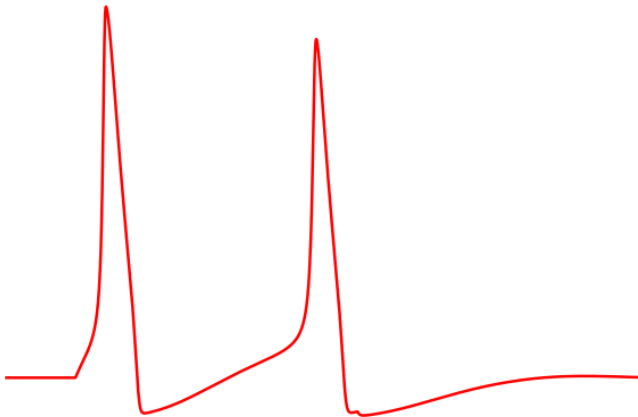


Neuronify

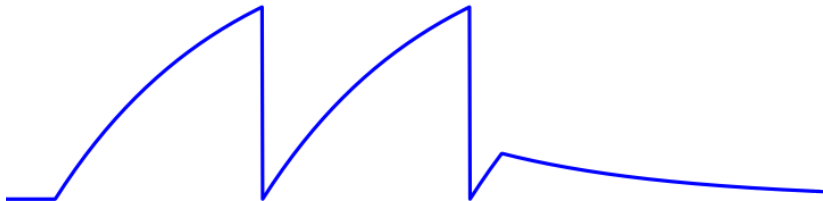


Exercises

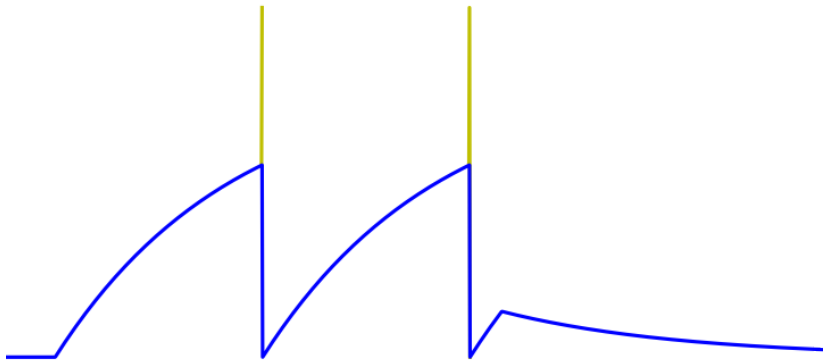
We do not need all information in the action potential for a neuron in a network and can create an approximation



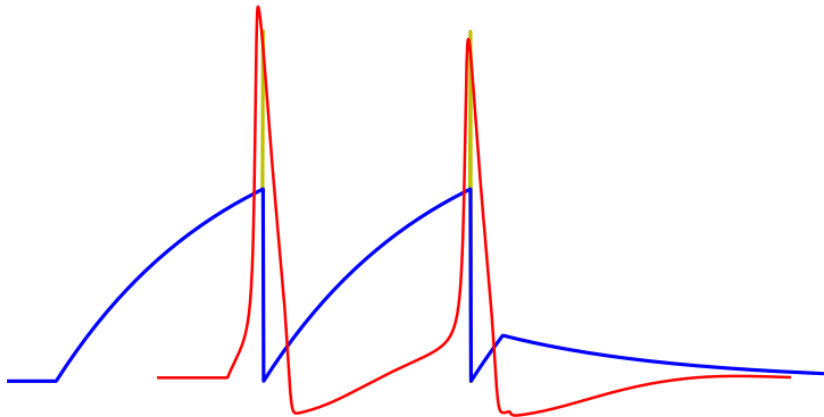
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The integrate and fire neuron is much faster to evaluate than the Hodgkin-Huxley neuron

Hodgkin-Huxley

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## Hodgkin-Huxley

$$\begin{aligned}C \frac{dV}{dt} &= I_{inj} - \bar{g}_{Na} m^3 h (V - V_{Na}) - \bar{g}_K n^4 (V - V_K) - g_L (V - V_L) \\ \frac{dn}{dt} &= \alpha_n(V)(1 - n) - \beta_n(V)n \quad \frac{dm}{dt} = \alpha_m(V)(1 - m) - \beta_m(V)m \\ \frac{dh}{dt} &= \alpha_h(V)(1 - h) - \beta_h(V)h \quad \alpha_n(V) = \frac{0.01(V + 55)}{1 - \exp[-(V + 55)/10]} \\ \beta_n(V) &= 1.125 \exp[-(V + 65)/80] \quad \alpha_m(V) = \frac{0.1(V + 40)}{1 - \exp[-(V + 40)/10]} \\ \beta_m(V) &= 4 \exp[-(V + 65)/18] \quad \alpha_h(V) = 0.07 \exp[-(V + 65)/20] \\ \beta_h(V) &= \frac{1}{1 + \exp[-(V + 35)/10]}\end{aligned}$$



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## Integrate and fire

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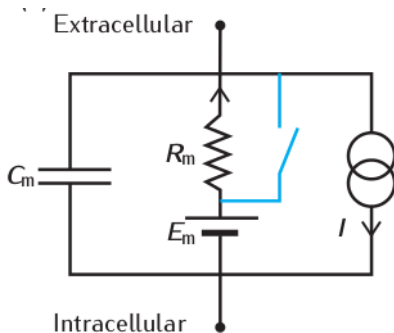
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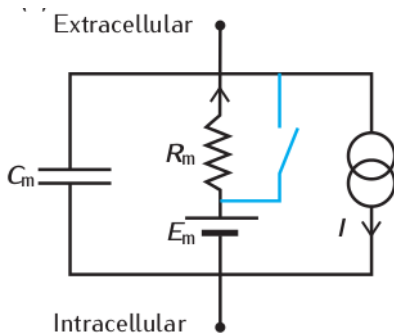
## Integrate and fire

$$C_m \frac{dV(t)}{dt} = - \frac{V(t) - E_m}{R_m} + I$$

The integrate and fire model is modeled as a simple RC circuit that is shortcircuited once a threshold is reached



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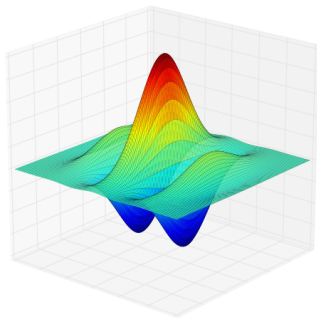


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# Receptive Field

$$r(t) = r_0 + \int \int D(\mathbf{r}, \tau) s(\mathbf{r}, t - \tau) d\tau d\mathbf{r} \quad (1)$$

Gabor function



# Receptive Field

