Neuronify: a new tool for creating simple neural networks

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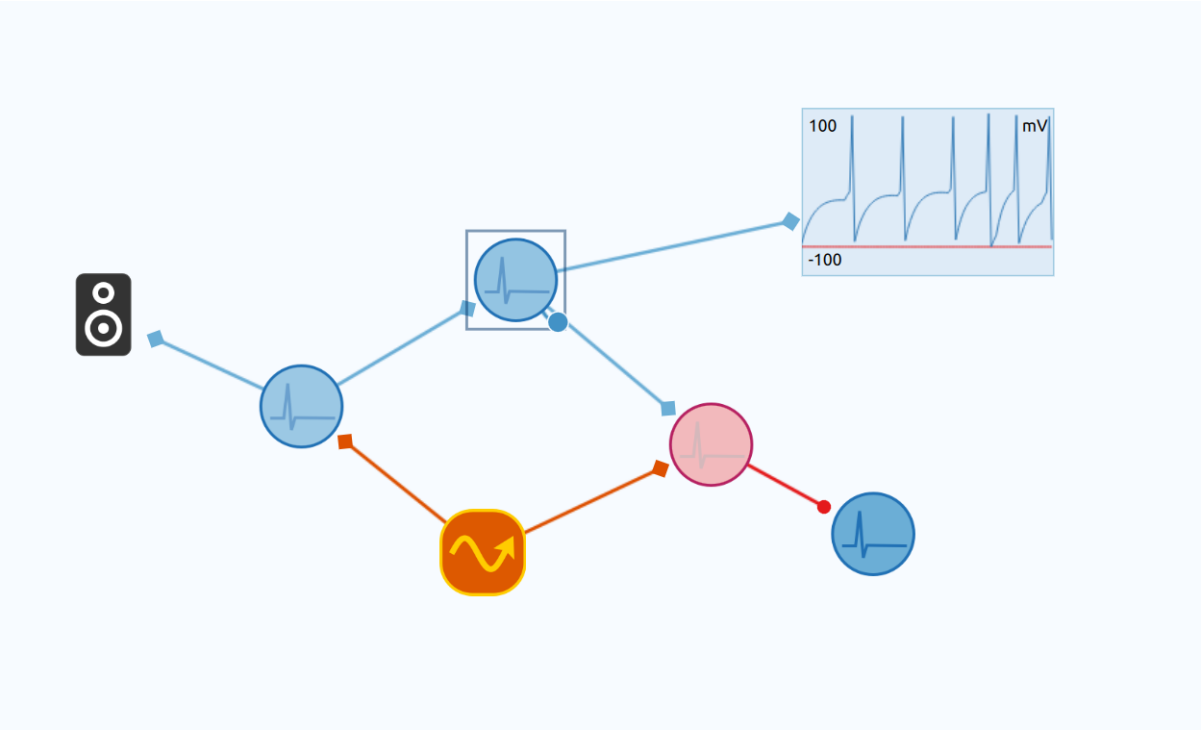

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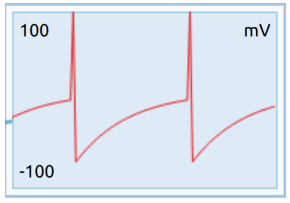
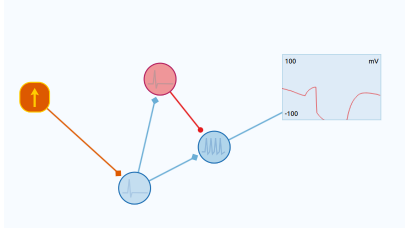
In this lecture we will introduce Neuronify, a new tool for creating neural networks



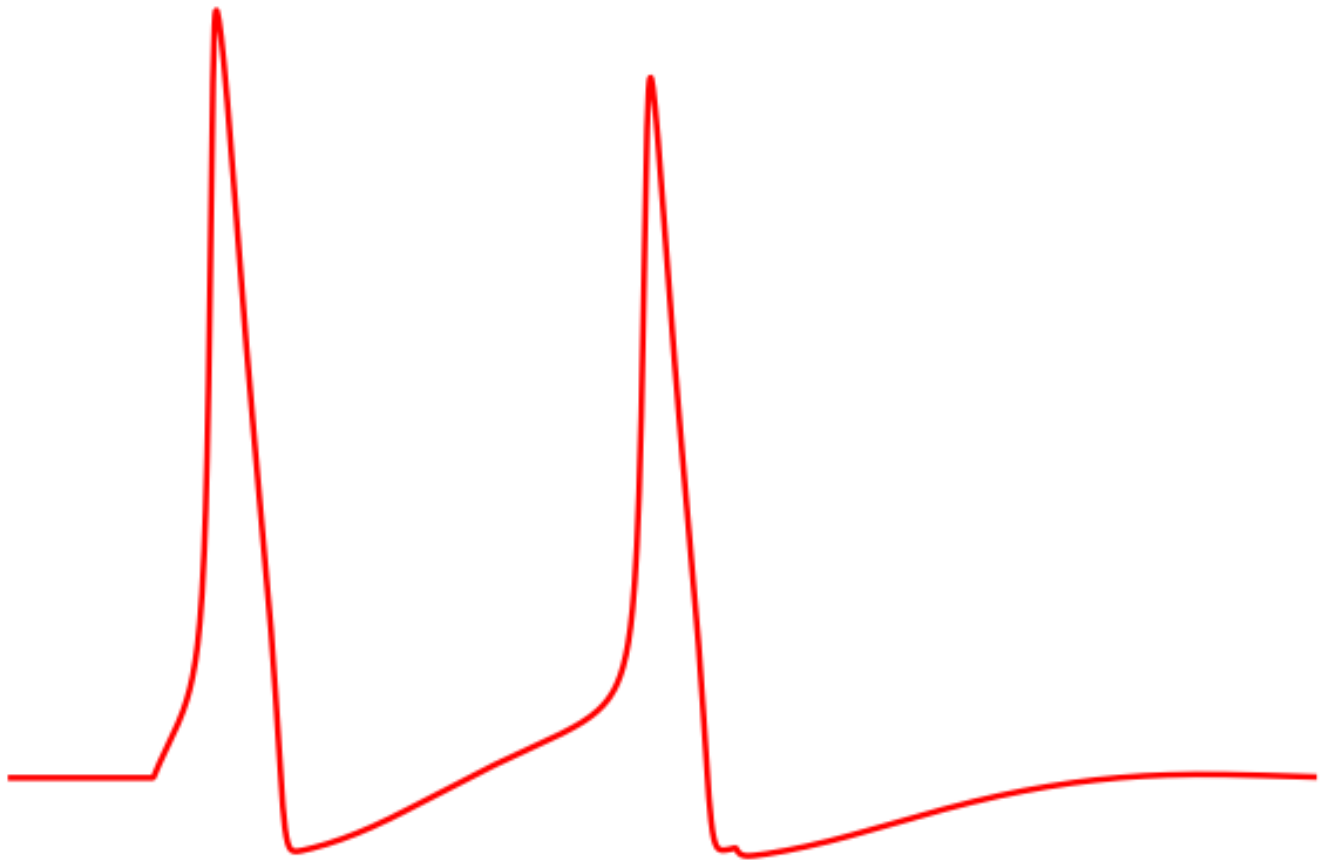
Integrate and fire neurons

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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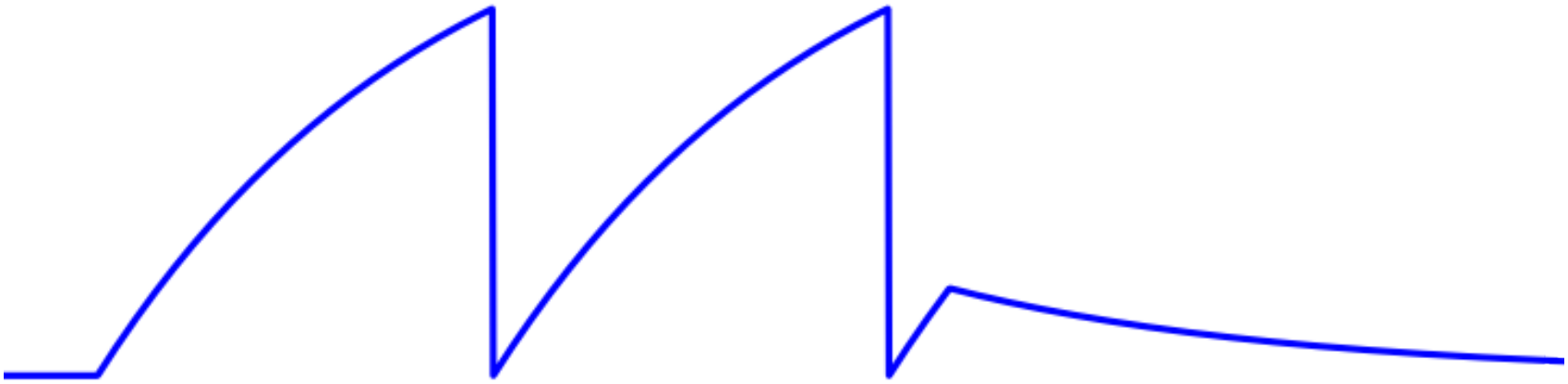

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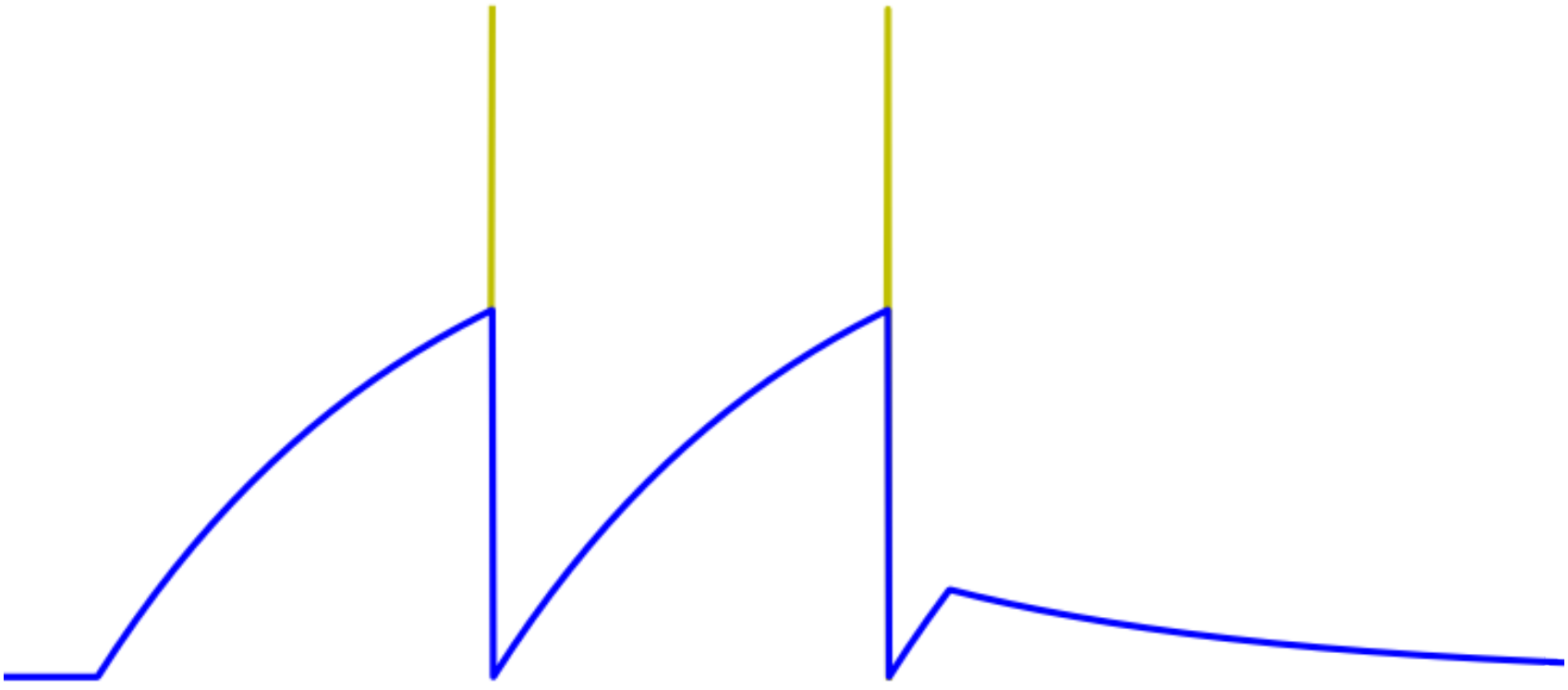

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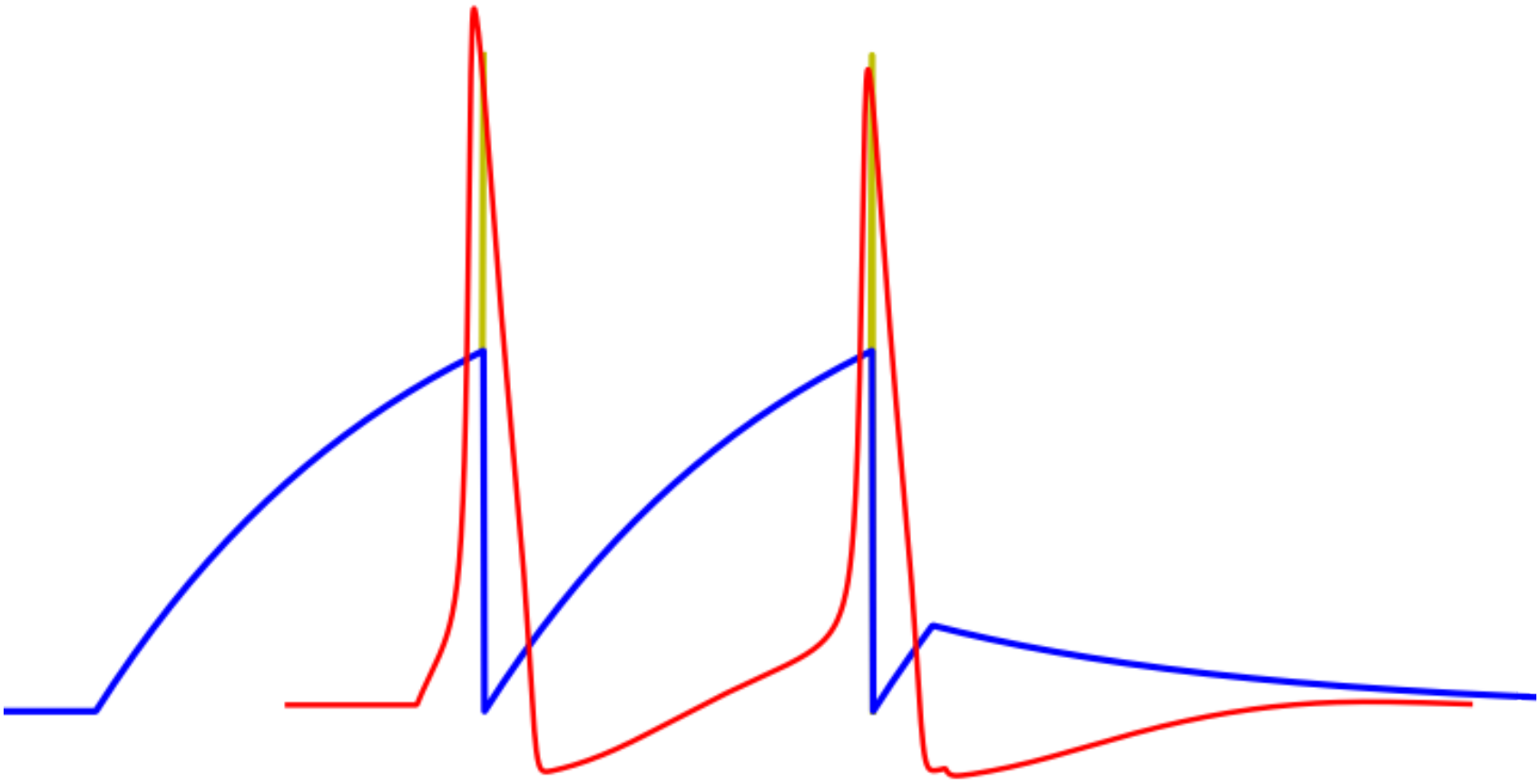

The integrate and fire neuron is much faster to evaluate than the Hodgkin-Huxley neuron

Hodgkin-Huxley

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Hodgkin-Huxley

$$C\frac{dV}{dt} = I_{inj} - \bar{g}_{Na} m^3 h(V - V_{Na}) - \bar{g}_K n^4 (V - V_K) - g_L(V - V_L)$$

$$\frac{dn}{dt} = \alpha_n(V)(1 - n) - \beta_n(V) n \quad \frac{dm}{dt} = \alpha_m(V)(1 - m) - \beta_m(V) m$$

$$\frac{dh}{dt} = \alpha_h(V)(1 - h) - \beta_h(V) h \quad \alpha_n(V) = \frac{0.01(V + 55)}{1 - \exp[-(V + 55)/10]}$$

$$\beta_n(V) = 1.125 \exp[-(V + 65)/80] \quad \alpha_m(V) = \frac{0.1(V + 40)}{1 - \exp[-(V + 40)/10]}$$

$$\beta_m(V) = 4 \exp[-(V + 65)/18] \quad \alpha_h(V) = 0.07 \exp[-(V + 65)/20]$$

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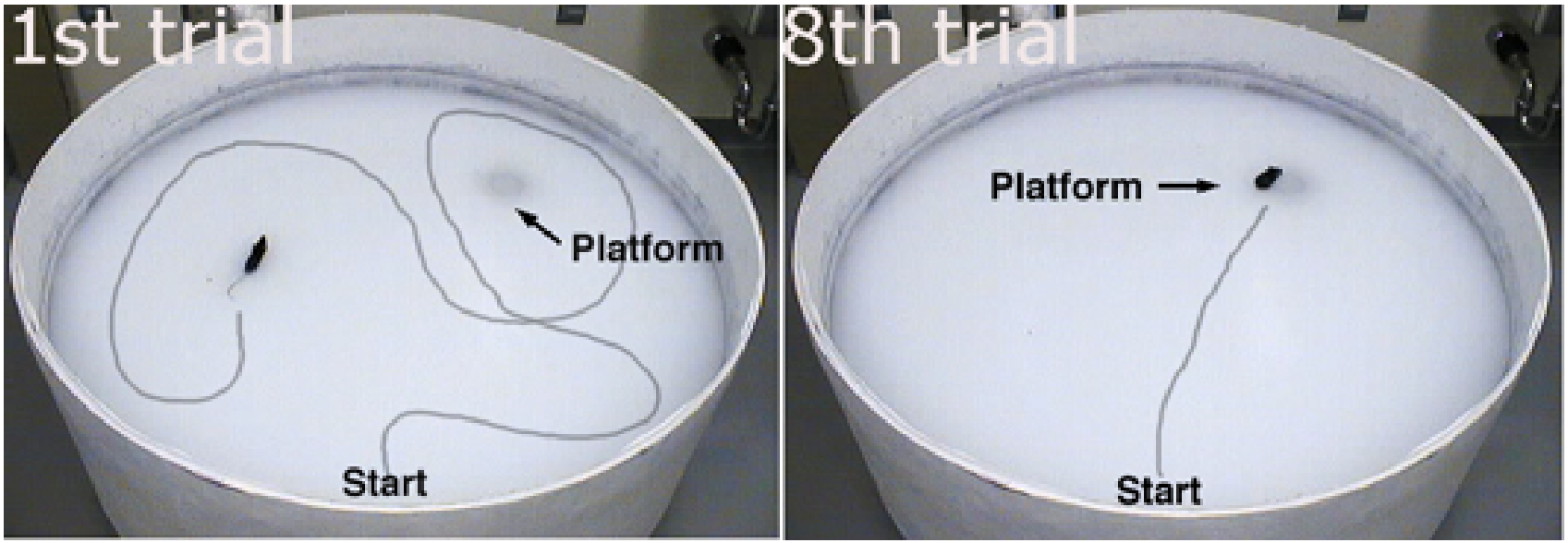
Integrate and fire

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

Example: learning in mice (Vasilaki et. al., 2009)



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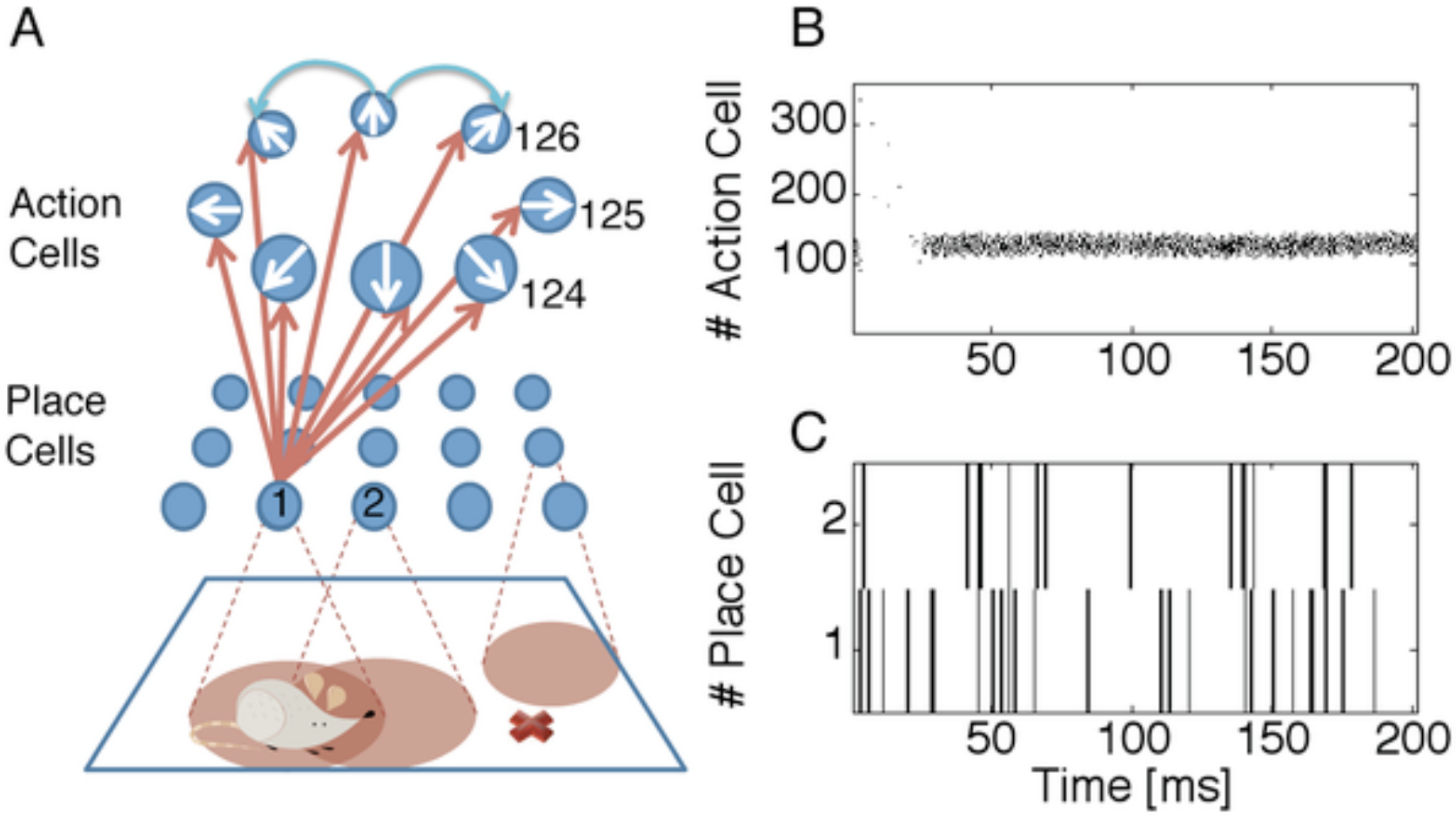

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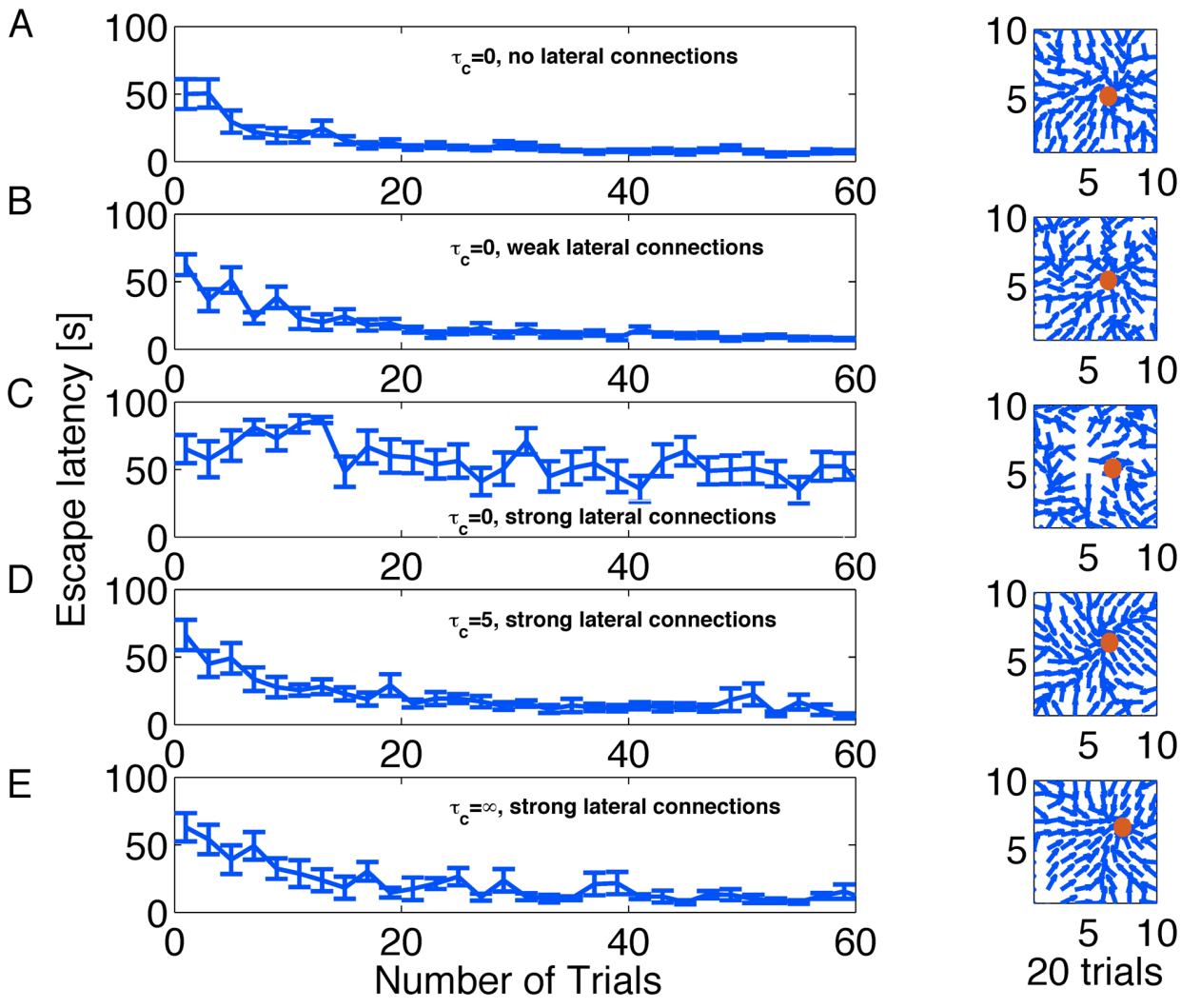

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Exercises