A system of interacting neurons stops spiking without external stimuli

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Membrane potential

Membrane Potential $=$ **Difference** in voltage between inside and outside of cell's membrane.

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The membrane potential changes due to:

- interaction with the environment (leakage)
- interaction with other neurons

Interaction among neurons

Two neurons interact through electrical and chemical processes.

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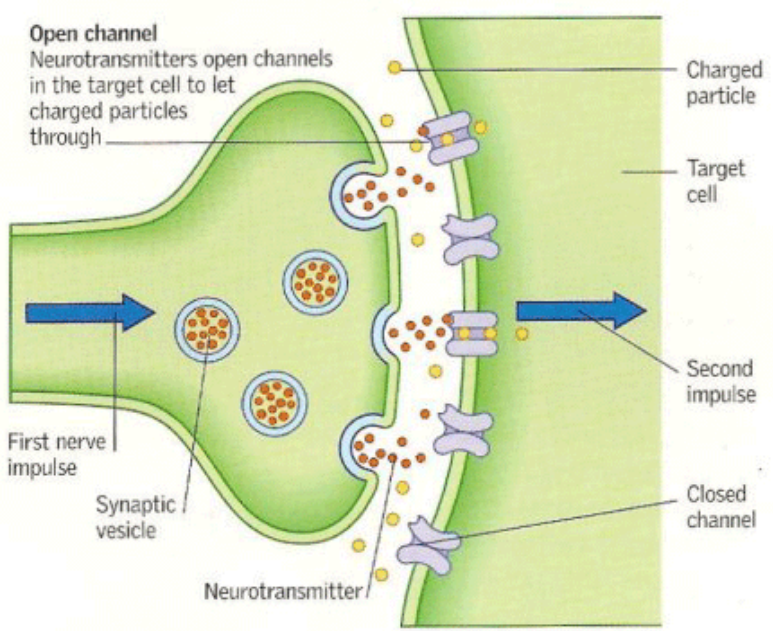

Interaction among neurons

Two neurons interact through electrical and chemical processes.

- Spike $\Longrightarrow$ Chemical transmission $\Longrightarrow$ **reset/receive** potential
- Gap junction $\Longrightarrow$ Electrical transmission $\Longrightarrow$ **share** potential

Question

Can a system of interacting neurons remain active/spiking **without** external stimuli?

The model

Ours is a stochastic model for a finite system of neurons with:

- chemical transmissions
- electrical transmissions
- leaking effect

Time evolution

When a neuron spikes:

- Its membrane potential is **reset** to 0.
- Neurons which are influenced by it **receive** (by chemical transmission) an additional positive potential.

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All the time:

- Leaking losses proportional to the membrane potential
- Gap junction action pushing potentials to an average value

Mathematical ingredients

- A constant defining the leaking rate.
- A constant describing the rate which the potentials converge to the average value.
- A spiking rate defined by an increasing function of the potential

Results

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Key: presence of leaking effect

Conclusion:

Theorem

The system has always only a **finite** *number of spikes*

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- Question: Can a system of interacting neurons remain active/spiking **without** external stimuli?
- Answer: **NO!**

Thanks!