Team SpikCore

Chipathon 2025

Spiking Mosbius

Team members
- Royce Richmond

# What is a spiking mosbius ? and why ?

Spiking mosbius

The chip proposal contains the building blocks for spiking neurons, analog synapses, and transmission gates, this elements with the cross-bar array gives us the ability to reconfigure the hardware, allowing us to test different neuronal networks.

Why it matters ?

Neuromorphic hardware has the capability to solve computing problems with a fraction of the power consumption of digital counterparts. Been able to reconfigure a chip for different tasks, datasets and outputs can help us to develop specialized chips

One neuron to rule them all - Axon Hillock neuron

One of the very first VLSI implementation of neurons is the Axon hillock neuron [1], we propose a modification emulating a floating gate and without a membrane capacitance (reducing the layout size)
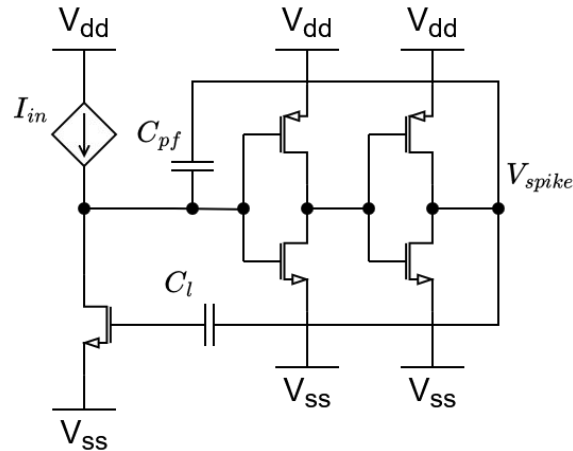
[1] Indiveri, G., Linares-Barranco, B., Hamilton, T. J., Schaik, A. van, Etienne-Cummings, R., Delbruck, T., Liu, S.-C., Dudek, P., Häfliger, P., Renaud, S., Schemmel, J., Cauwenberghs, G., Arthur, J., Hynna, K., Folowosele, F., Saighi, S., Serrano-Gotarredona, T., Wijekoon, J., Wang, Y., & Boahen, K. (2011). Neuromorphic Silicon Neuron Circuits. Frontiers in Neuroscience, 5. https://doi.org/10.3389/fnins.2011.00073

# Excitatory inhibitory activity on the brain

Neurons communicate through electrical currents called action potentials, which are either excitatory or inhibitory, the different input of the neurons allows the brain to learn different patterns.
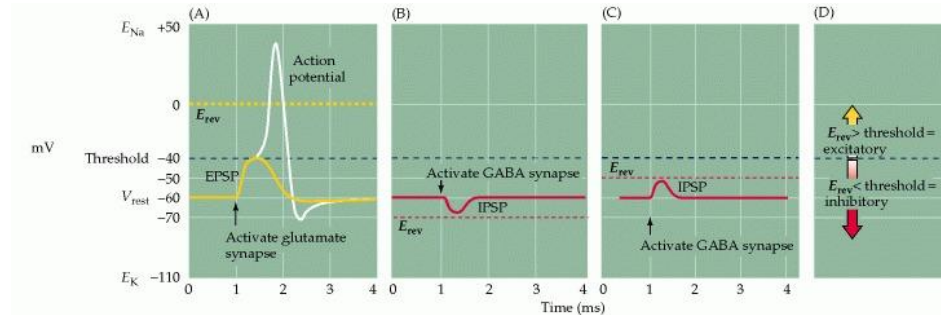
Purves D, Augustine GJ, Fitzpatrick D, et al., editors. Neuroscience. 2nd edition. Sunderland (MA): Sinauer Associates; 2001. Excitatory and Inhibitory Postsynaptic Potentials. Available from: https://www.ncbi.nlm.nih.gov/books/NBK11117/

Excitatory inhibitory synapses

The goal is to simplify the building blocks by utilizing synapses that can function as either excitatory or inhibitory. This approach allows us to create diverse types of neurons without requiring distinct designs or specifications for each type.
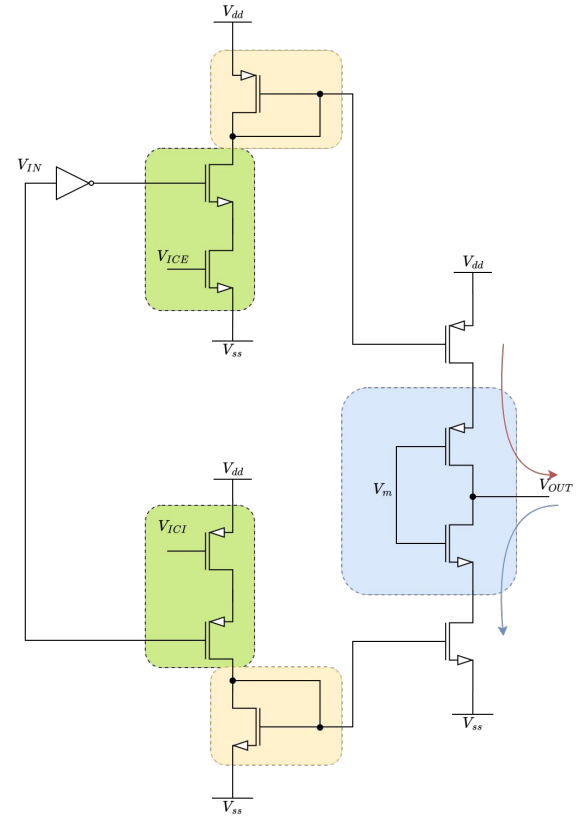
from paper down to bitstream

We need a way to convert the idea (neural architecture to bitstream), we plan on a python script that will generate said bitstream

mosbius already has serial communication and a crossbar array
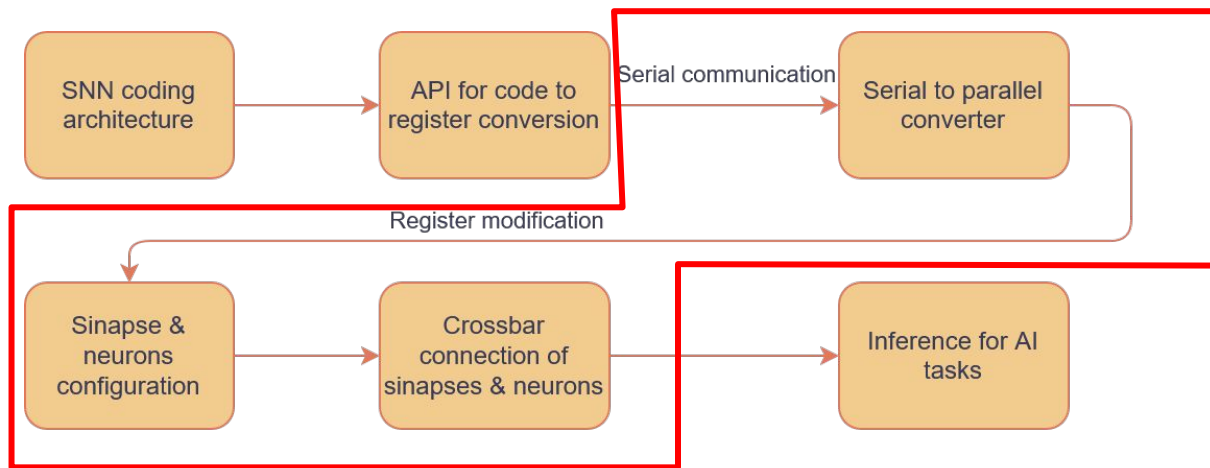
Turn on only what you use

We don't need everything on all the time.
We can turn on single elements and reduce the static power consumption (in simulation it works, in reality we don't really know how good it would be, we have leakage currents)
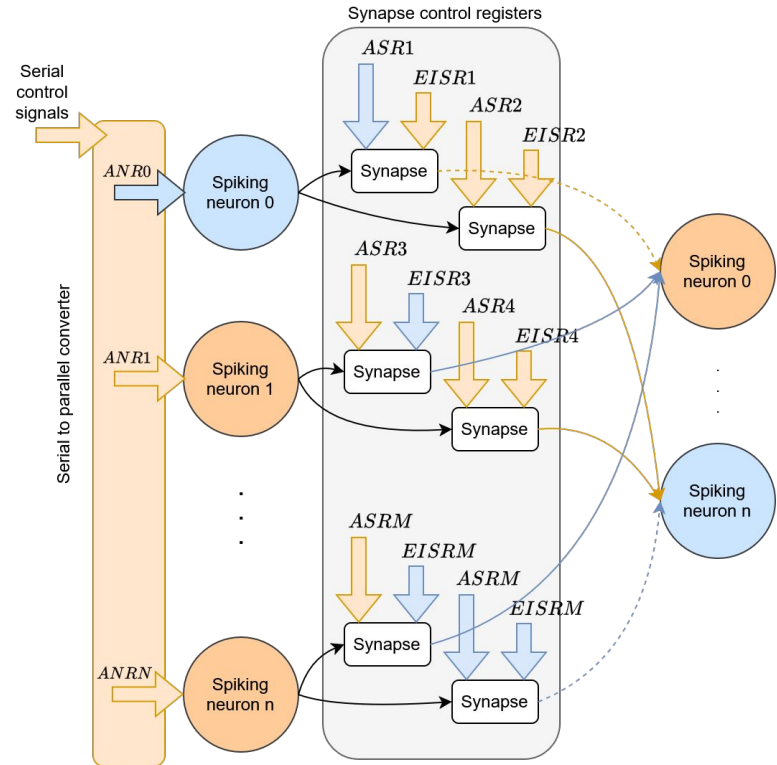
Expand the existing hardware

The current hardware for controlling the switch matrix already has D-type flip flops, non-overlapping clocks and a platform to upload the Bitstream File into the MOSbius Chip

Why create new hardware ? when we can expand the existing one and use the same programming platform (plus some tweaks) to turn on and off elements of our chip
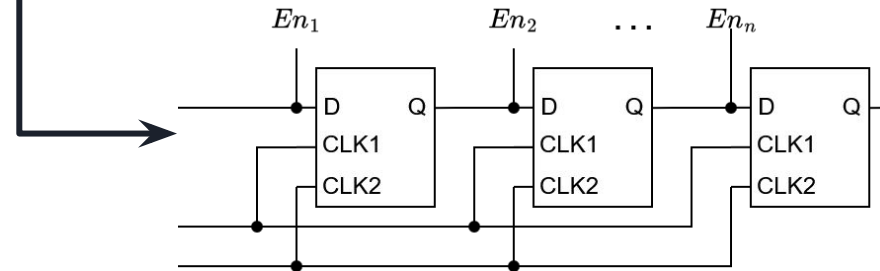
Expand the existing hardware

Existing control path for mosbius

......x650
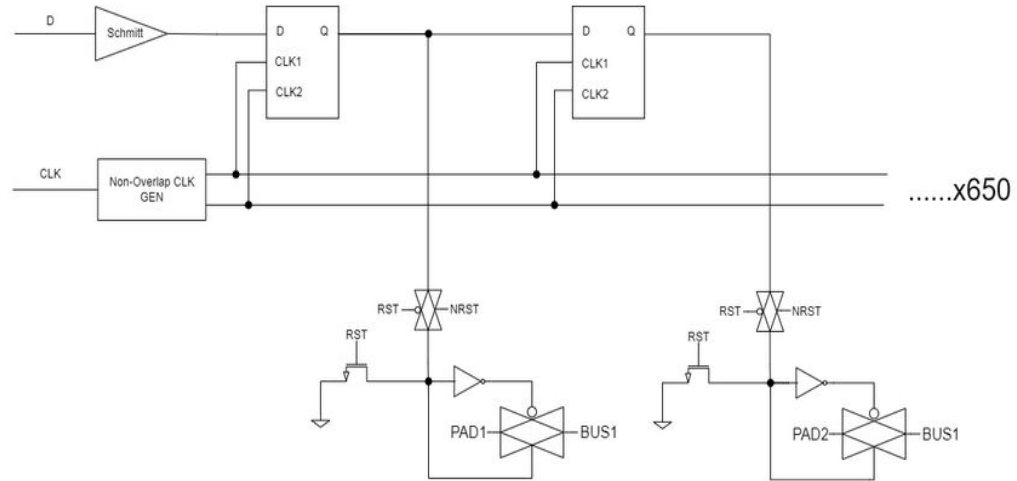
additional control path using an overflow

Mosbius Pinout