

Unsupervised Online Learning with Digital Spiking Neural Networks

ODIN 28nm SNN

Technology	28nm FDSOI
Implementation	Digital
Area	0.086mm ² ← 0.68μm ² /syn
#Synapses	64k
#Neurons	256
Online learning	SDSP, (3+1)-bit weight
#Izhikevich behav.	20
Time constant	Biological to accelerated
Supply voltage	0.55V – 1.0V
Leakage power	16.5μW – 160μW
Energy per SOP	9.8pJ @0.55V

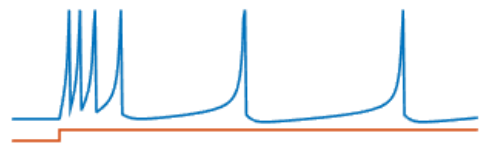
Unsupervised Online Learning

Key ingredients

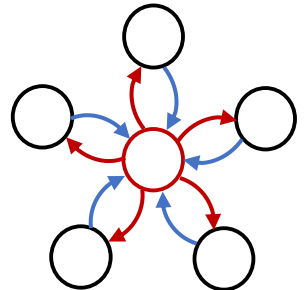
Online learning rule

$$\begin{cases} w \rightarrow w+1 & \text{if } V_{\text{mem}} \geq \theta_m, \theta_1 \leq Ca < \theta_3 \\ w \rightarrow w-1 & \text{if } V_{\text{mem}} < \theta_m, \theta_1 \leq Ca < \theta_2 \end{cases}$$

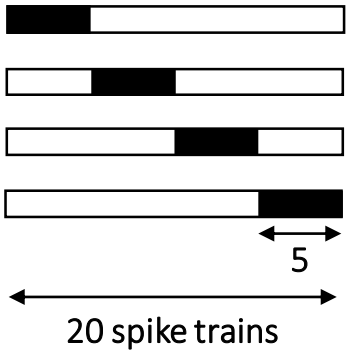
Spike frequency adaptation



Winner-take-all circuits



Stimuli (4 patterns)



Results

There is a nice little demo for you! 😊

