

LEAKY INTEGRATE AND FIRE NEURON

$$u(t) = \underbrace{\beta u(t-1)}_{\text{DECAY}} + \underbrace{w x(t)}_{\text{INPUT}} - \underbrace{S_{\text{out}}(t-1) \theta}_{\text{RESET}} \quad \leftarrow \text{threshold}$$

membrane potential

$$S_{\text{out}}(t) \in \{0, 1\} = \text{output spike} \quad \begin{cases} 1 & \text{reset term subtracts threshold from membrane potential} \\ 0 & \text{no effect} \end{cases}$$

$$S_{\text{out}}(t) = \begin{cases} 1 & u(t) > \theta \\ 0 & \text{otherwise} \end{cases}$$

BN + (bin)

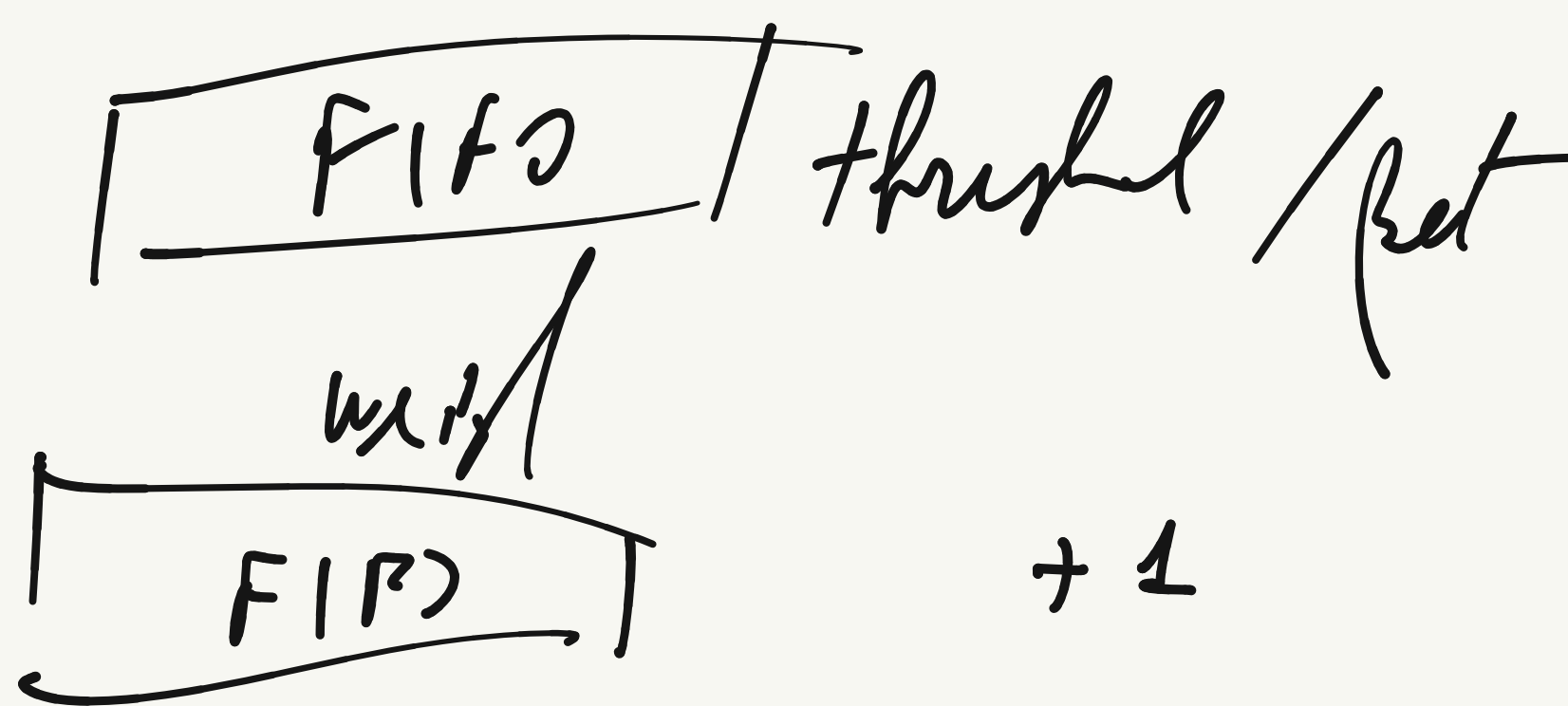
$$\gamma = (1 - \beta)$$

$$u(t) = (1 - \gamma) u(t-1) + w x(t)$$

β	γ	shift
0.5	0.5	1
0.75	0.25	2
0.875	0.125	3
0.9375	0.0625	4
0.96875	0.03125	5
0.984375	0.015625	6
0.9921875	0.0078125	7
1	0	0

$$u(t) = \underbrace{u(t-1)}_{\text{membrane-potential-accumulator}} - \underbrace{\gamma u(t-1)}_{\text{decay-potential} = \beta u(t-1)} + w x(t)$$

complement and sum



0, 1, 0, 1, 0

NO DIFFERENCE \rightarrow encode θ directly, needed if θ

$$NO \rightarrow u(t) - \theta > 0$$

$$\text{Spike} = \begin{cases} 1 & \rightarrow \text{sum} \\ 0 & \rightarrow \text{no sum} \end{cases}$$