AP2 - Neural Networks

[Deep learning in Spiking neural networks]

Spiking neuron → transfer function is usually non differentiable, which prevent using back propagation.

SNN (method) → Supervised method
→ unsupervised method

ANN → ① continuous activation values and a set of weighted inputs
② These units are commonly called "neurons" because of their biological inspiration. The non-spiking neural are differentiable and non-linear-activation function.

⇒ The spike trains are represented by sums of ~~directed~~ Dirac delta functions and don't have derivatives. This makes it difficult.

SNN - in Biological neuron, a spike is generated when the running sum of changes in the membrane potential, which can result from presynaptic Simulation.

1 SNN architecture → ① spiking neurons.
② Interconnecting synapse [modified Adjustable weight].

Implement SNN

Encode Analog input data into one of the following-
① Rate Based method ② temporal coding
③ population coding.

Rules in SNN

SNN → used to perform weight adjustment is both local to synapse and local to time.

SNN → [supervised & unsupervised]

prosthetic limb

① Collect data. → data contain EMG signal which measure the electrical activity of muscle data.

② Design SNN [Multi layer] * → choose no. of neuron, connection b/w neuron, and algorithm. should be designed to able to learn to control limb

③ (train that SNN model)

④ Evaluate the spiking neural network.

↳ after training check how it works on different task.

→ trained using collected data.

neural coding occupied a same

RP → (TDSNN) from Deep Neural Networks to Deep Spike Neural Networks with temporal coding

youtube : training spiking neural networks using lessons from deep learning

--

→ Neural networks trained with deep learning are the state of the art in AI/ML

The Best of both worlds = [Biologically plausible neural nets + Back propagation]

* Such as Biological neural Network, neurons communicate with each other with discrete electric signals called spike and work in continuous time.

Rate Coding and temporal Coding ?

Temporal coding → ① Encode information by precise timing of spikes.

include
- → sensory information
- → Motor control
- → memory.
- → motion
- → Auditory system.

② Auditory system → Neuron in cochlea fire a spike at the onset of a sound. This allows brain of a sound as discrete event.

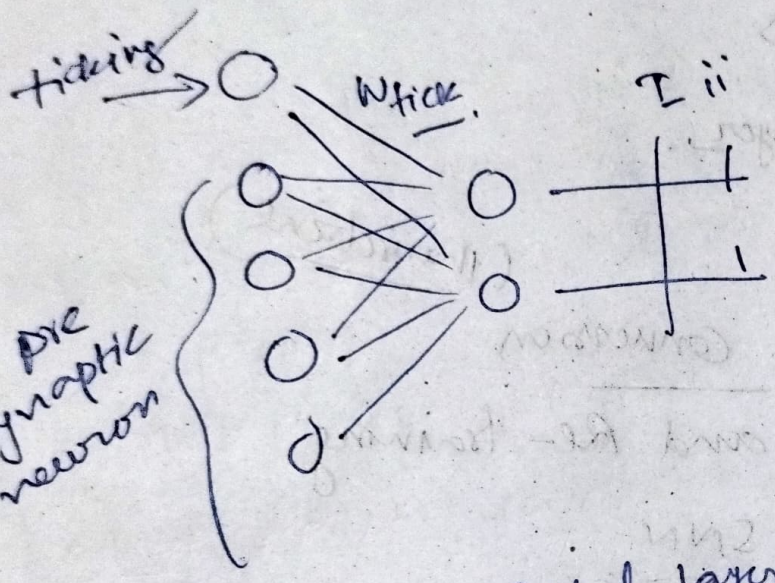
③ thought to be more important for tasks that require the brain to represent discrete event.

Rate coding → ① Neural coding scheme in which the average firing rate of a neuron is used to represent information. The firing rate is typically measured in $\frac{\text{Spike}}{\text{second}}$.

idea - 1 (Hybrid approach)

"develop a spiking neural network that can learn to control a prosthetic limb using both rate coding and temporal coding."

SNN - Model ↳



Mapping Synapse - Based layer ⇒

$$\sum_{t=0}^{T_0} W_{tick} \cdot \exp\left(-\frac{T_0 - t}{L}\right) + P \cdot \exp\left(-\frac{T_0}{L}\right) \geq \theta \rightarrow ① \checkmark$$

pooling layer → POOL,

inner product layer → IP ✓

Common Neural Model

(1) integrate and fire Model. (IF)

(2) Leaky integrate and fire model - (LIF)

↓ leaky constant λ ✓

!

ticking neuron mechanism →

(1) mapping synapse Based layer.

(2) mapping max-pool

(Neuronal)

network Conversion

(1) DNN adjustment and Re-training

(2) Forward propagation of SNN.