AI and Deep Learning

Artificial Intelligence and Brain

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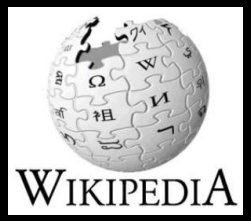
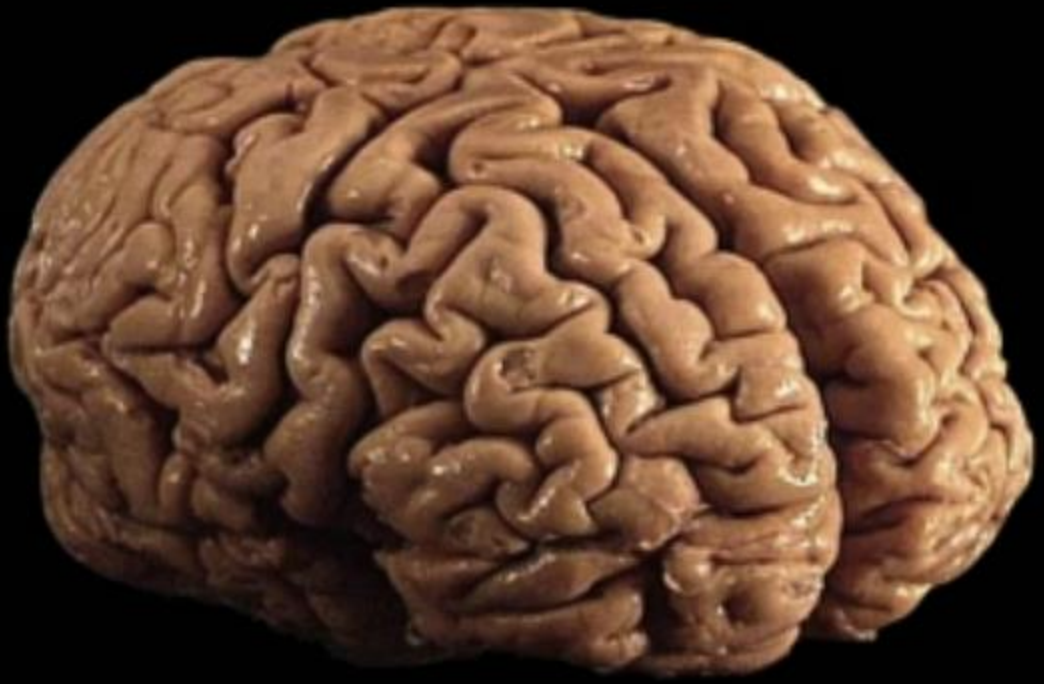
Agenda

- Artificial Intelligence
- AI Applications
- 4th Industrial Revolution
- Brain and Neuron
- Neural Networks
- Learning and Synapse

Intelligence?



- One's capability for logic, understanding, self-awareness, learning, planning, creativity, and problem solving
- The ability to perceive information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment
- Human Intelligence = Natural Intelligence



Artificial Intelligence

- Intelligence exhibited by machines
- A computerized version of the human intelligence
- Theory and development of computer systems able to perform tasks such as visual perception, voice recognition, decision-making, and translation between languages

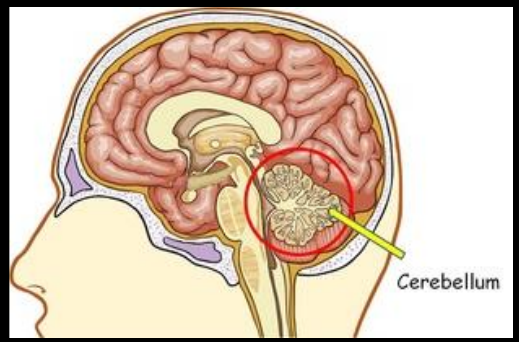
How can machines get AI?

What happens inside the human brain?

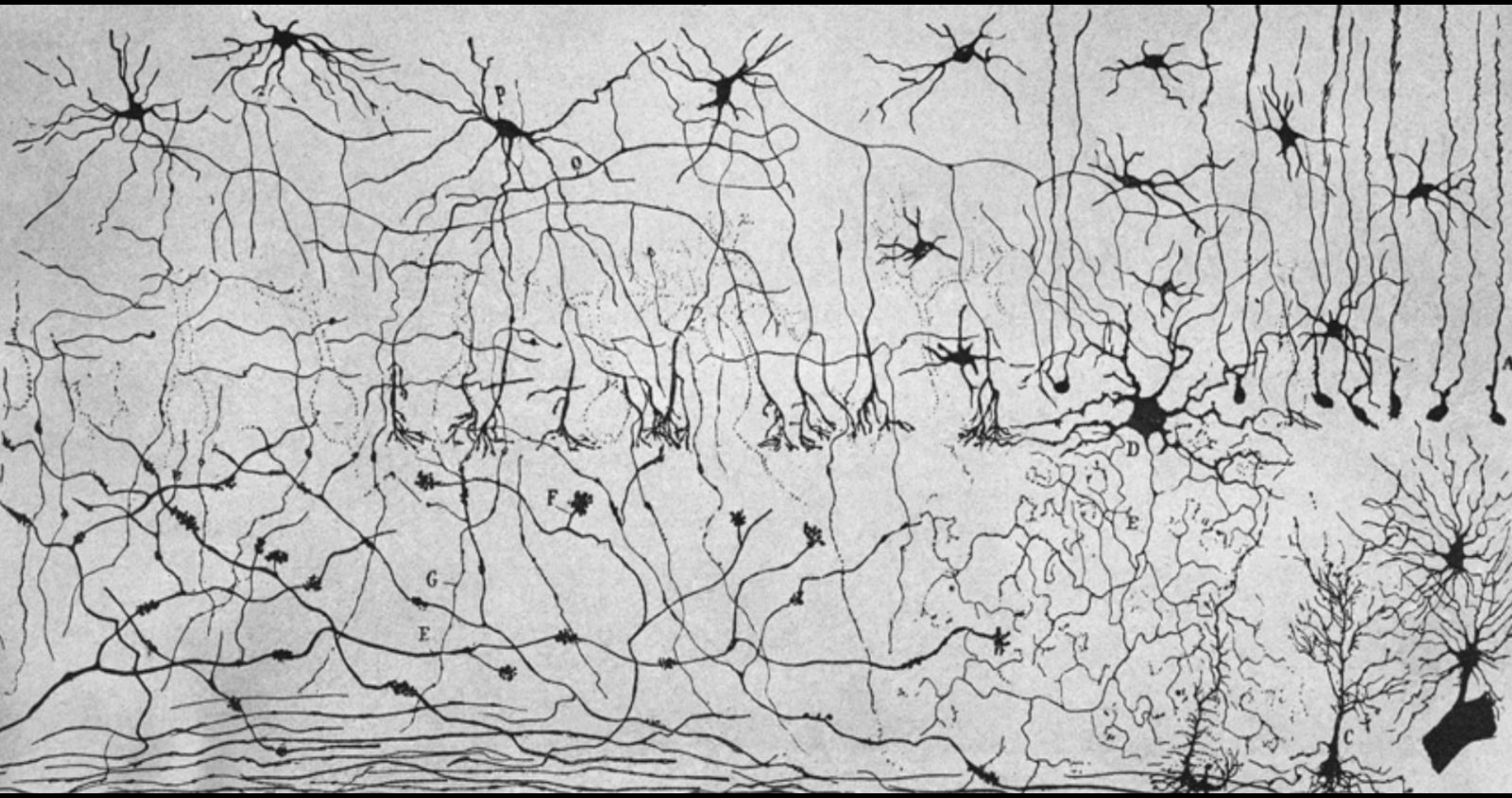
Neuroanatomist

Santiago Ramón y Cajal, 1852-1934

Cerebellum(소뇌) : controls muscles



Neurons in a bird's brain



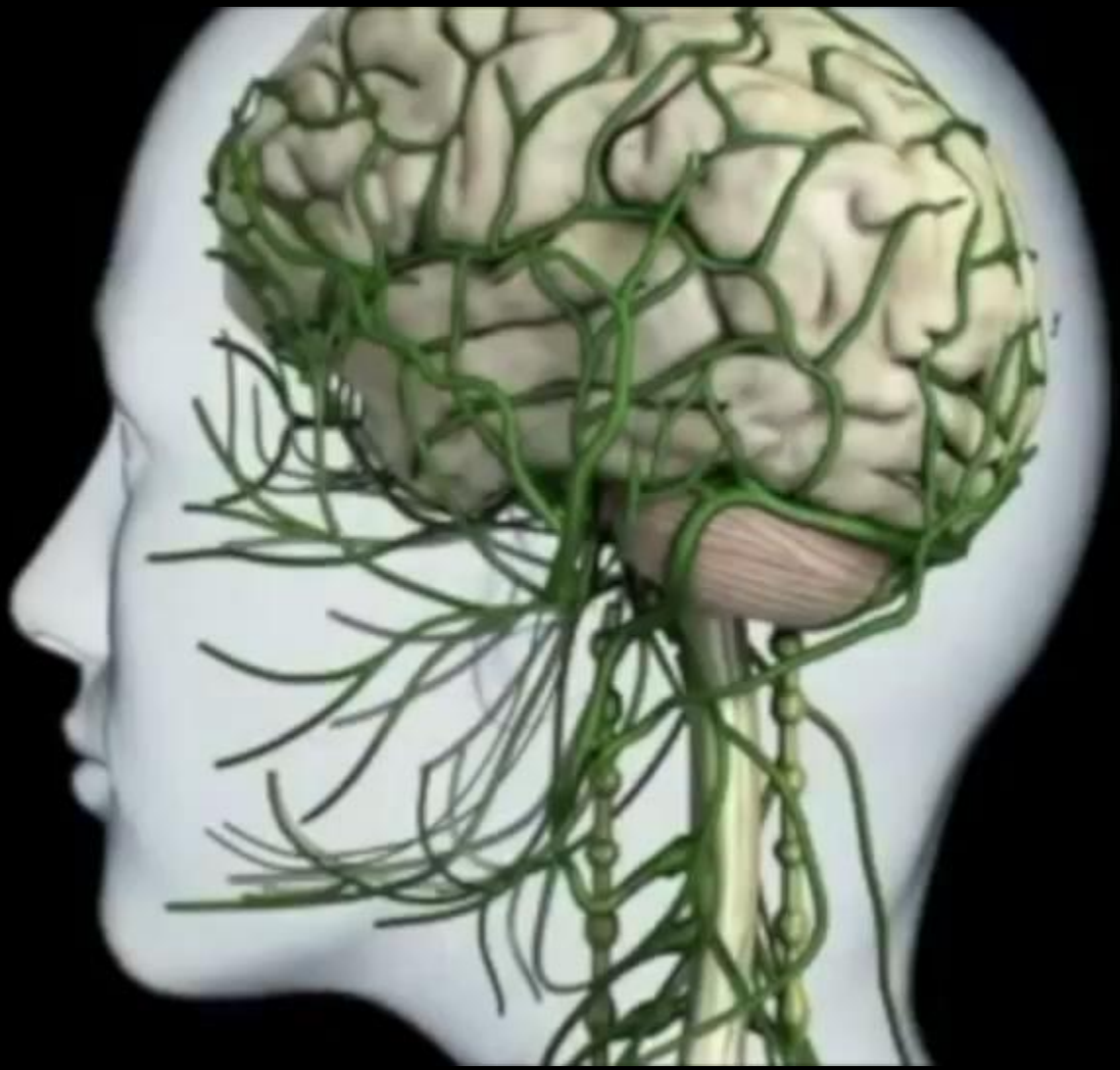
Ramón y Cajal's drawing of the neurons in a bird's cerebellum – a part of the brain.

Brain of Human


1
2
3
4
5
6
7

100 billion neurons
more than
the number of stars
in the universe

So, what happens inside?

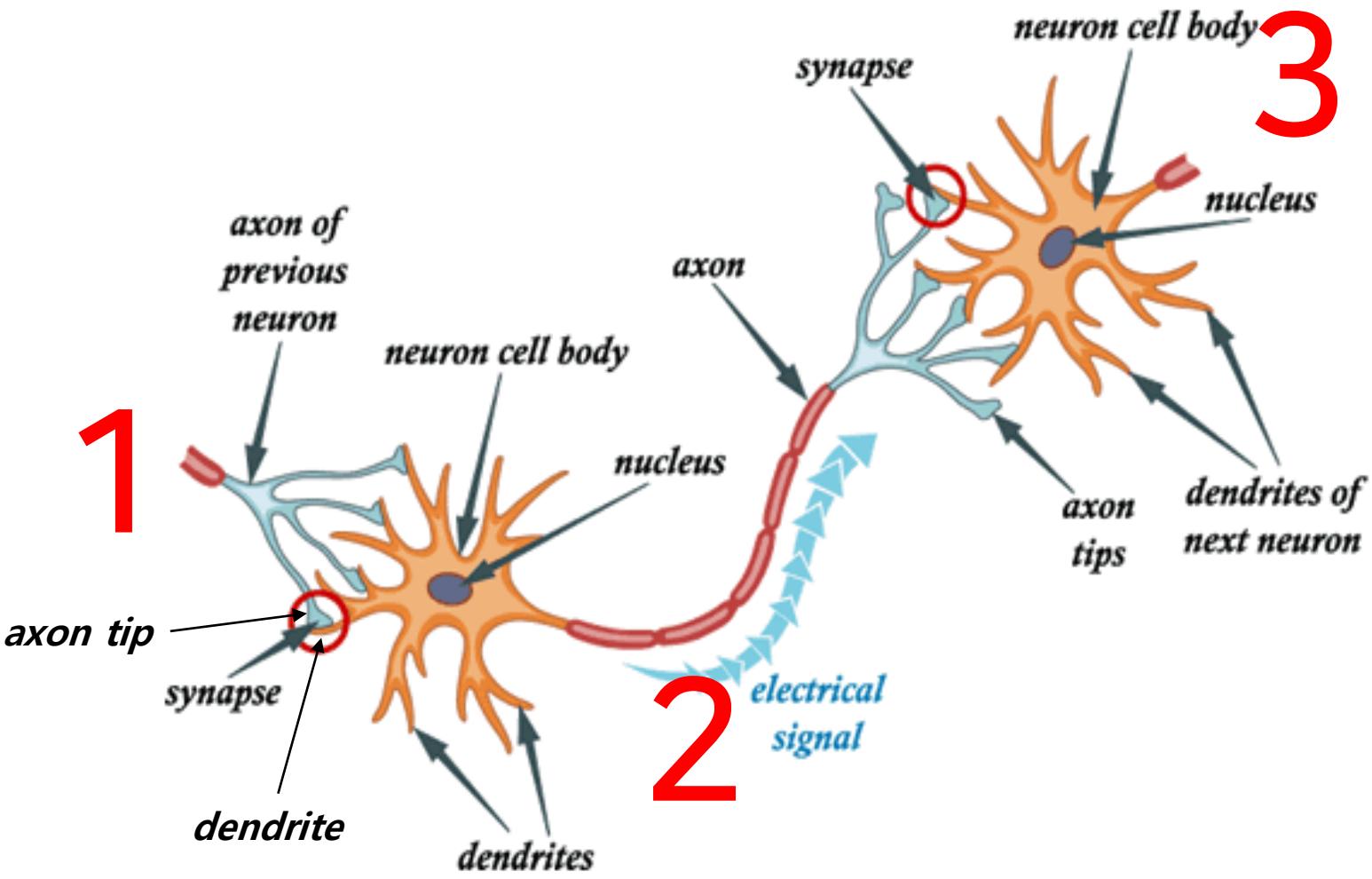


From a DVD that comes with the illustrated medical atlas, The Human Brain, DK Publishing UK.

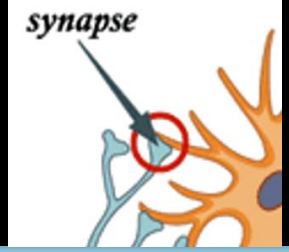
ON or OFF

- Signal or no signal
- Two states (simple)

Connection between neurons

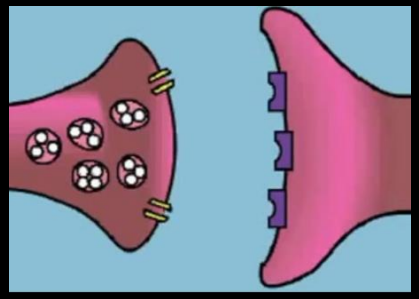


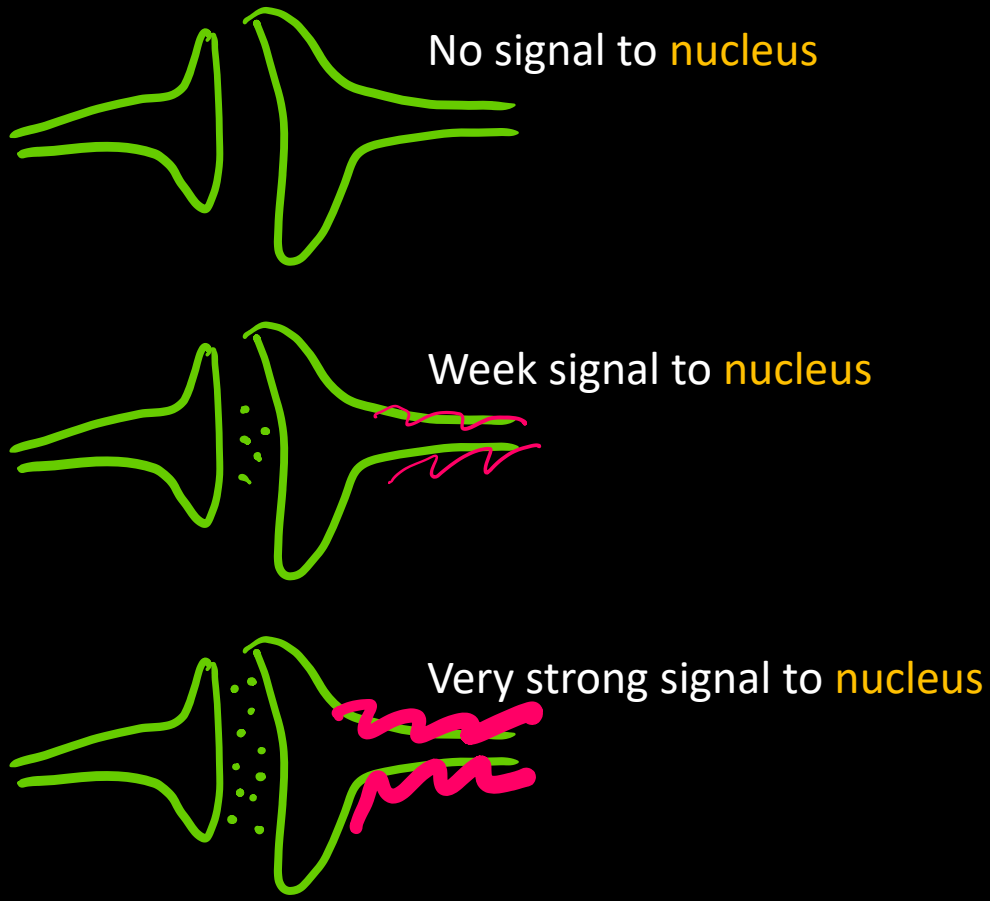
Synapse



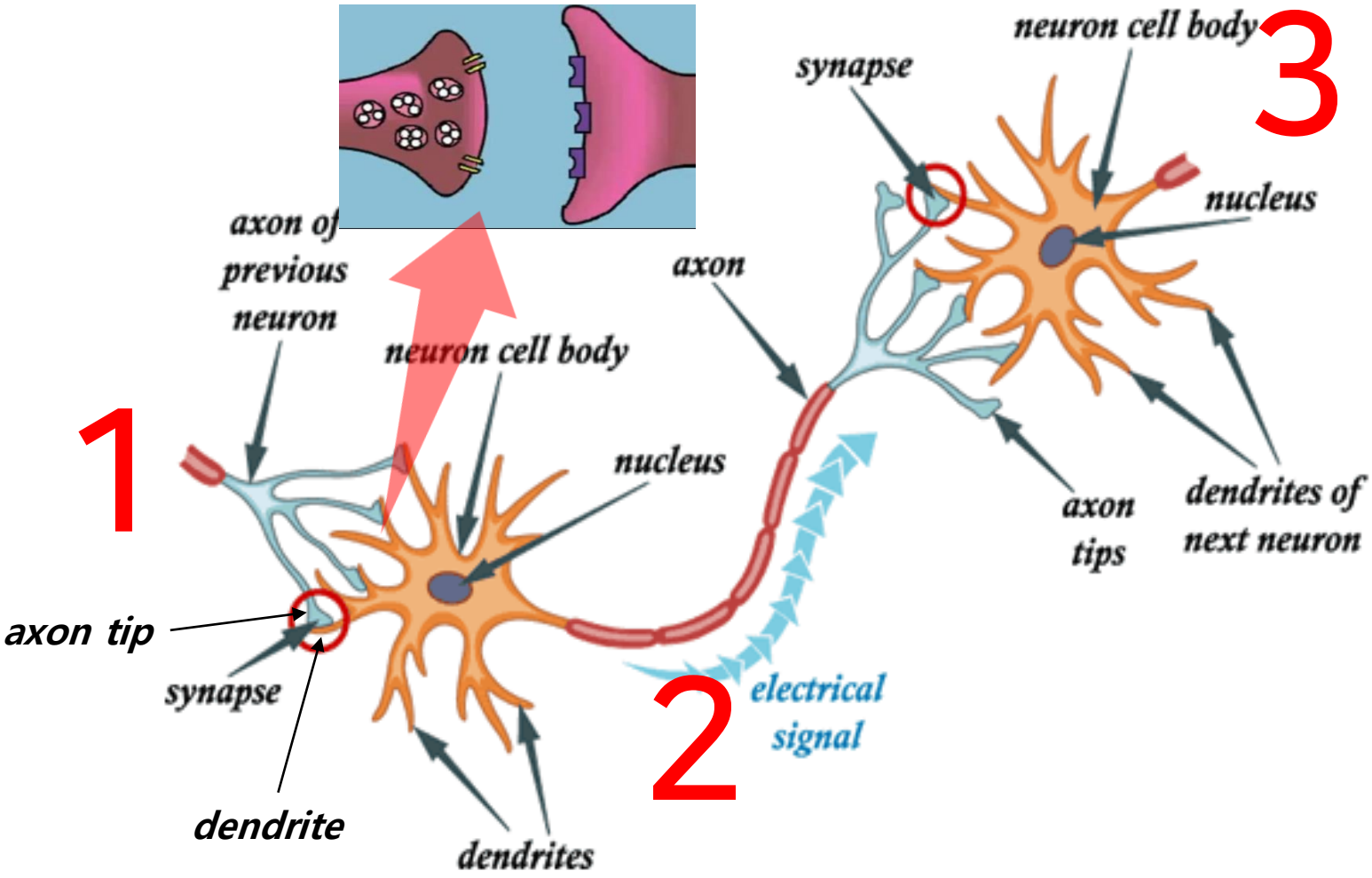
Neurotransmitter
in synapse

Various amount of neurotransmitter in each synapse




No signal to nucleus
Week signal to nucleus
Very strong signal to nucleus

Connection between neurons



Our memory, thinking, moving, emotion, and everything

Alzheimer’s, Paralysis

Simulation(signaling)

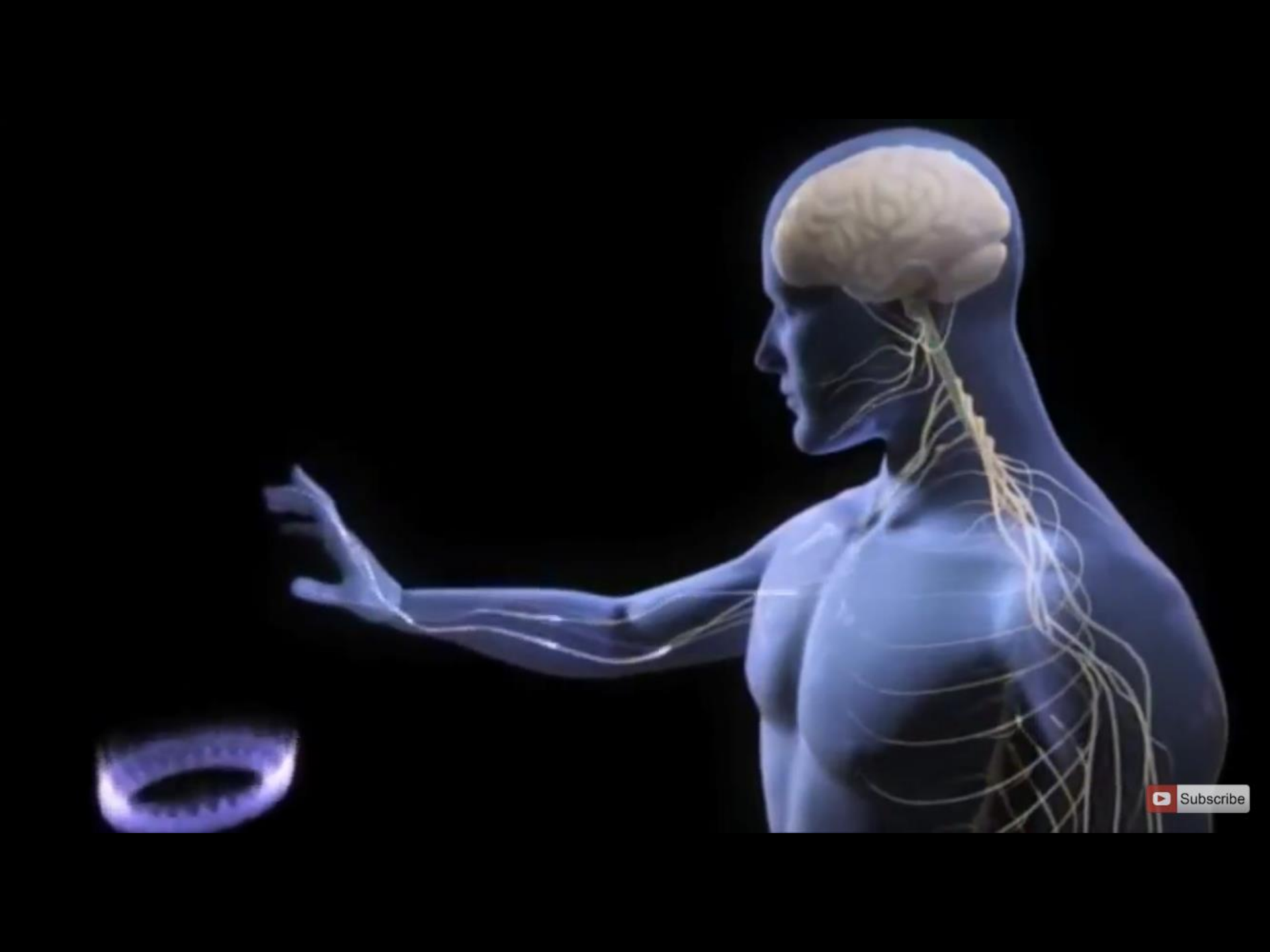
A brain in a supercomputer | Henry Markram

A neuron
has a simple function,
ON or OFF
(two states)

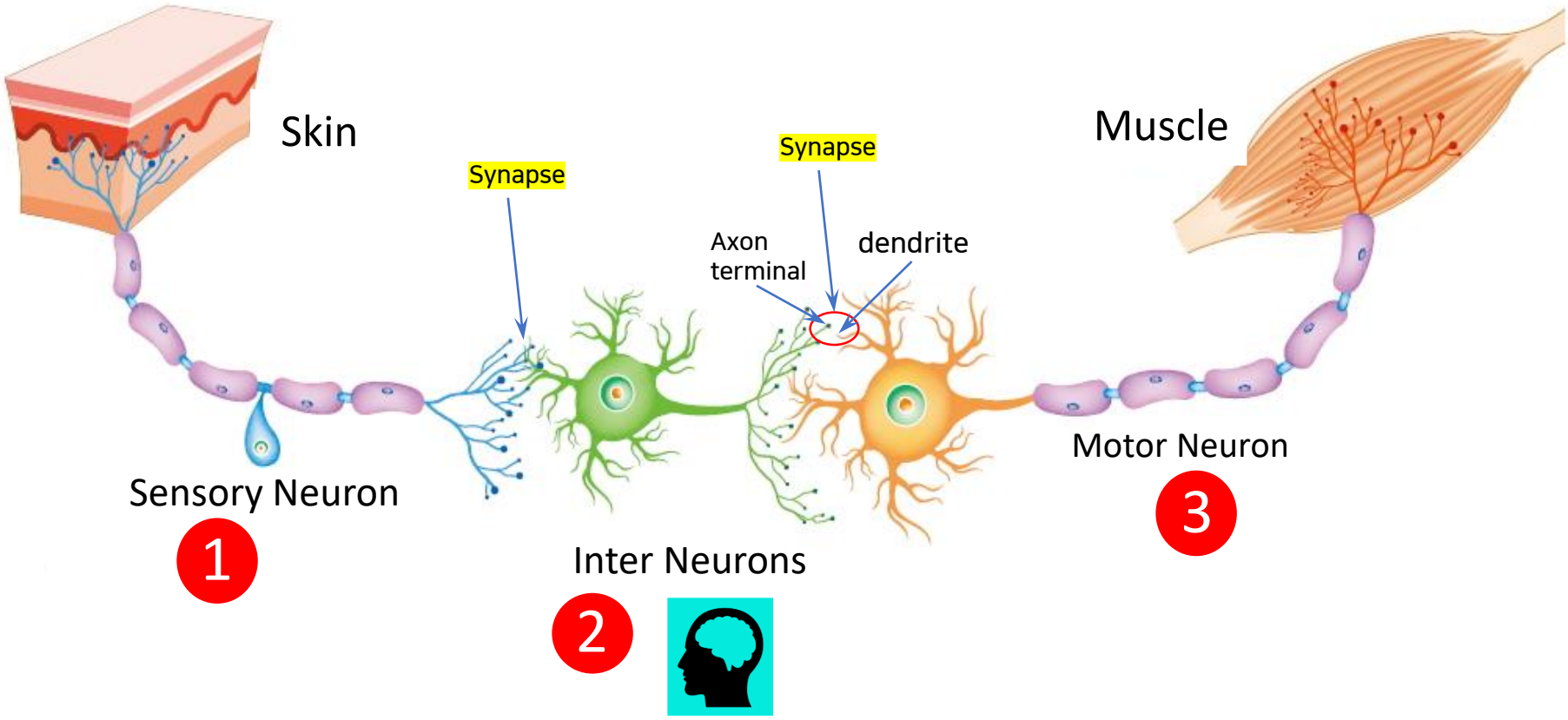
but huge amounts of neurons &
connections among them,

Everything we do is enabled by electrical signals running through our neural networks.

High-level functions from the connection of simple functional neurons


Subscribe

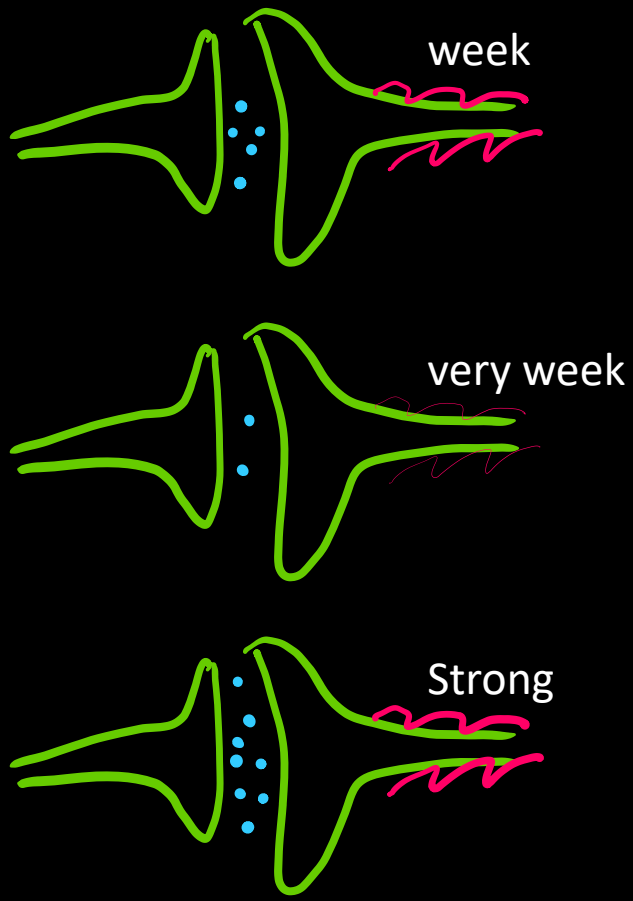
우리 몸에 있는 엄청나게 많은 뉴런들을 아주 간단히 표현하면..



Is just the connection enough?

Huge amounts of neurons &
the initialized connections
among them

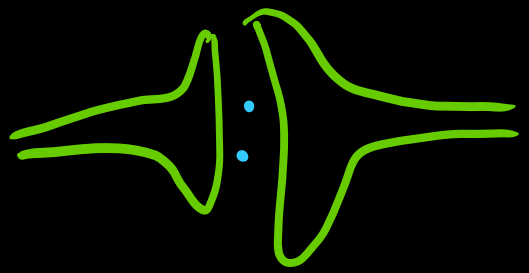
Automatic update of connections
while experiencing


week
very week
Strong


Happiness
Stress

“

Learning

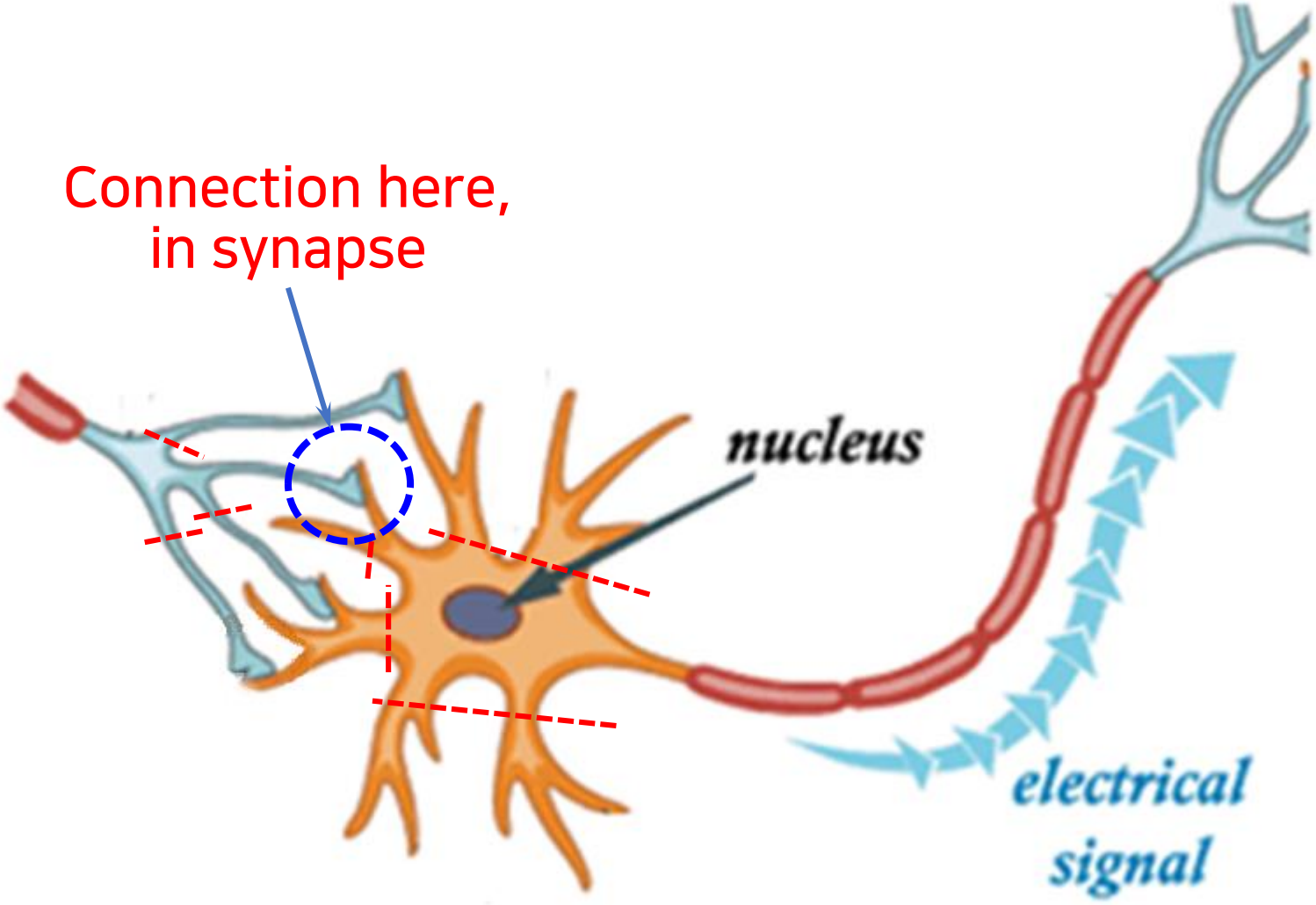


Adjusting the amount of neurotransmitter

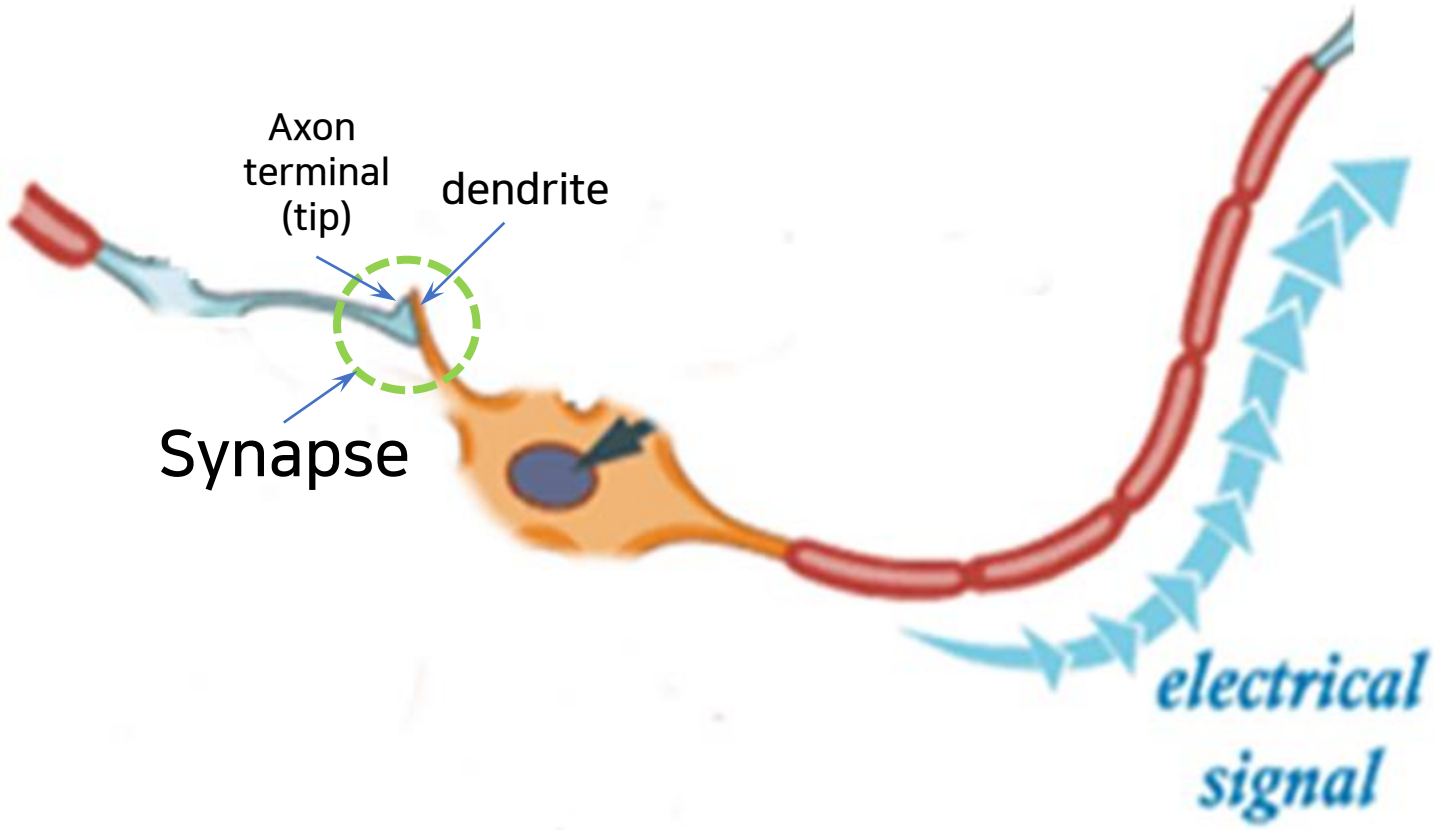
S/W implementation

→AI

The connections

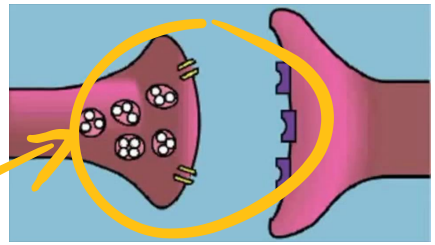


A Neuron with 1 Input



Action of a neuron

- The amount of neurotransmitter
- The strength of connection

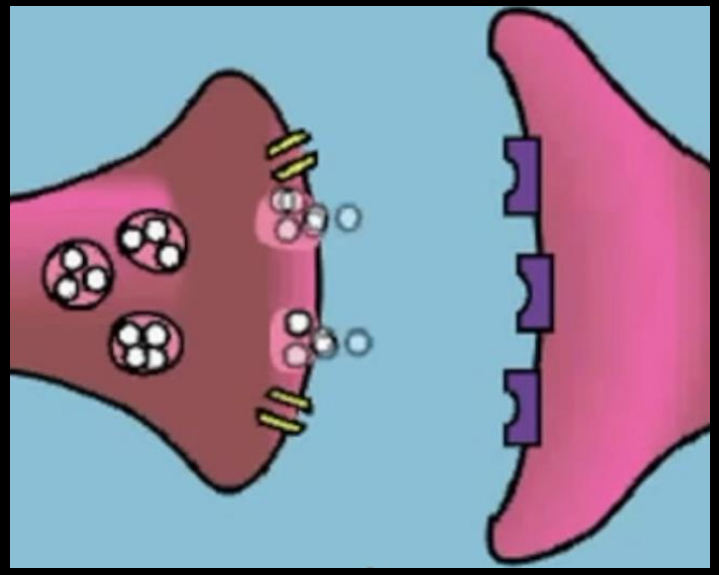


$$h = wx$$

Strength of a connection (w)

Amount of neurotransmitter & the strength of a signal

The amount of neurotransmitter



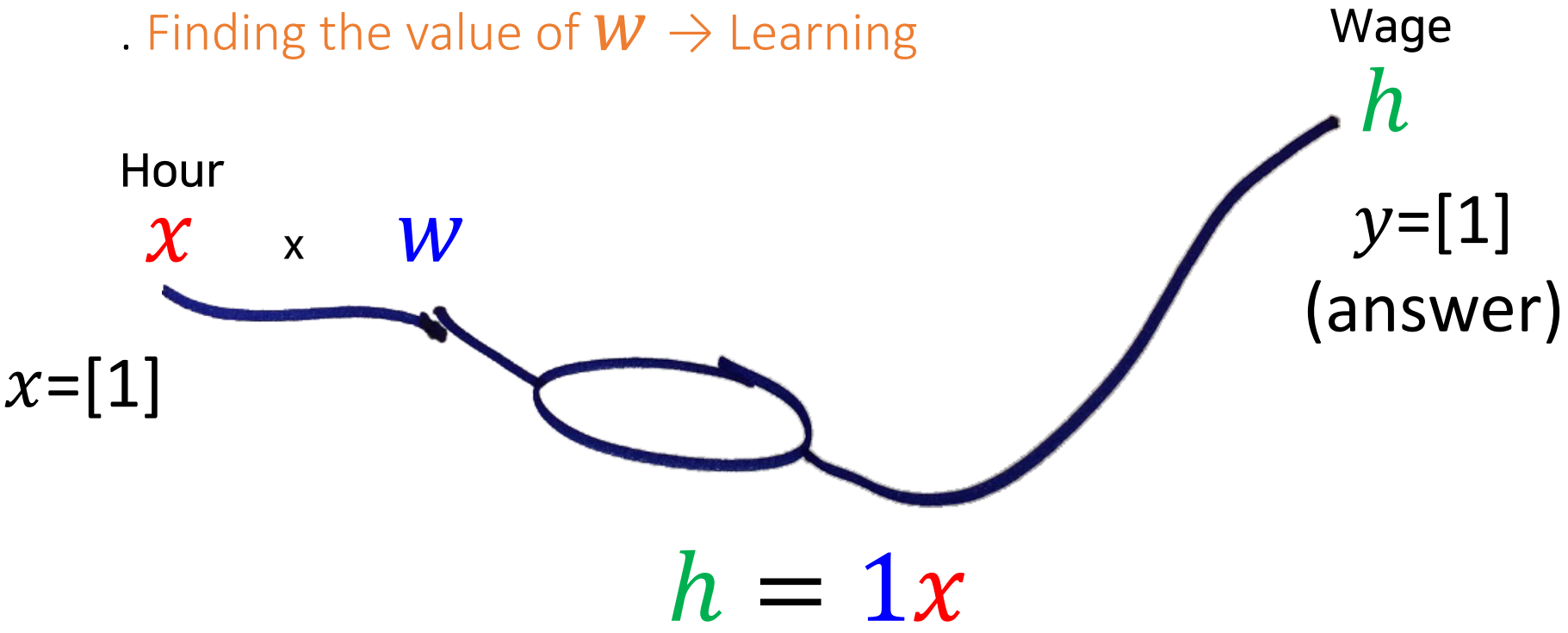
if large,
if small,
if not exist,

Application: Wage Calculator

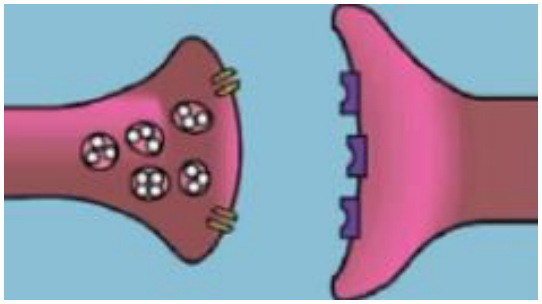
. Knowledge: 1 hour working(x) → 1USD(y) pay

. How much you get if work 4 hours? (prediction)

. Finding the value of W → Learning



x (hour)	w	output of a neuron	y (wage)	error	Reaction
1	4(random)	4	1	4-1	scolding seriously
1	2	2	1	2-1	ordinarily
1	1.5	1.5	1	1.5-1	not bed
1	1.3	1.3	1	1.3-1	good but not enough
1	1.1	1.1	1	1.1-1	acceptable



Scolding a dog/dolphin/child automatically updates the connection strength(w) to make the error smaller in the next step.

Learning

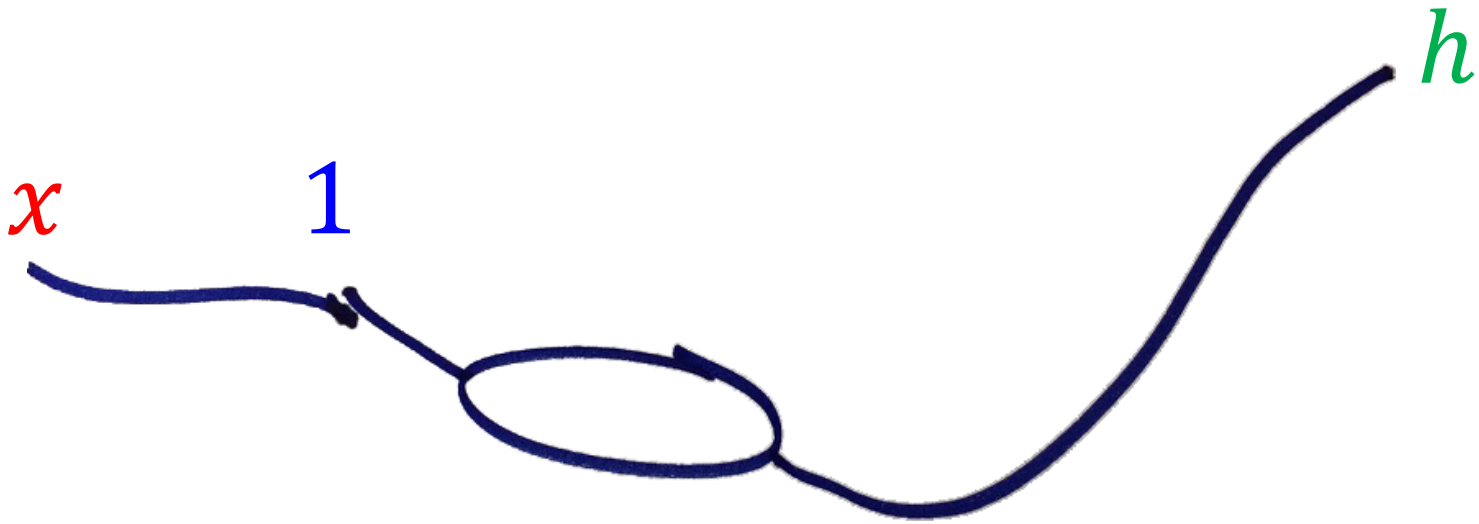
is to find the optimal value of parameter(w) to predict correctly.

the amount of neurotransmitter

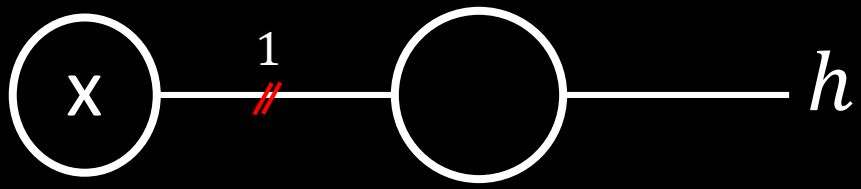
Drawing a neuron

Representing the below equation:

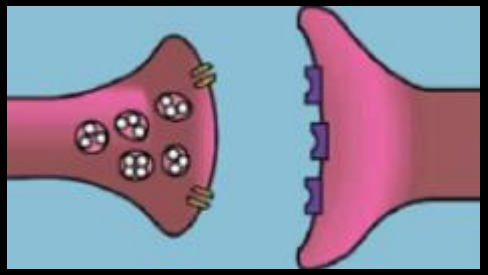
$$y = 1x$$



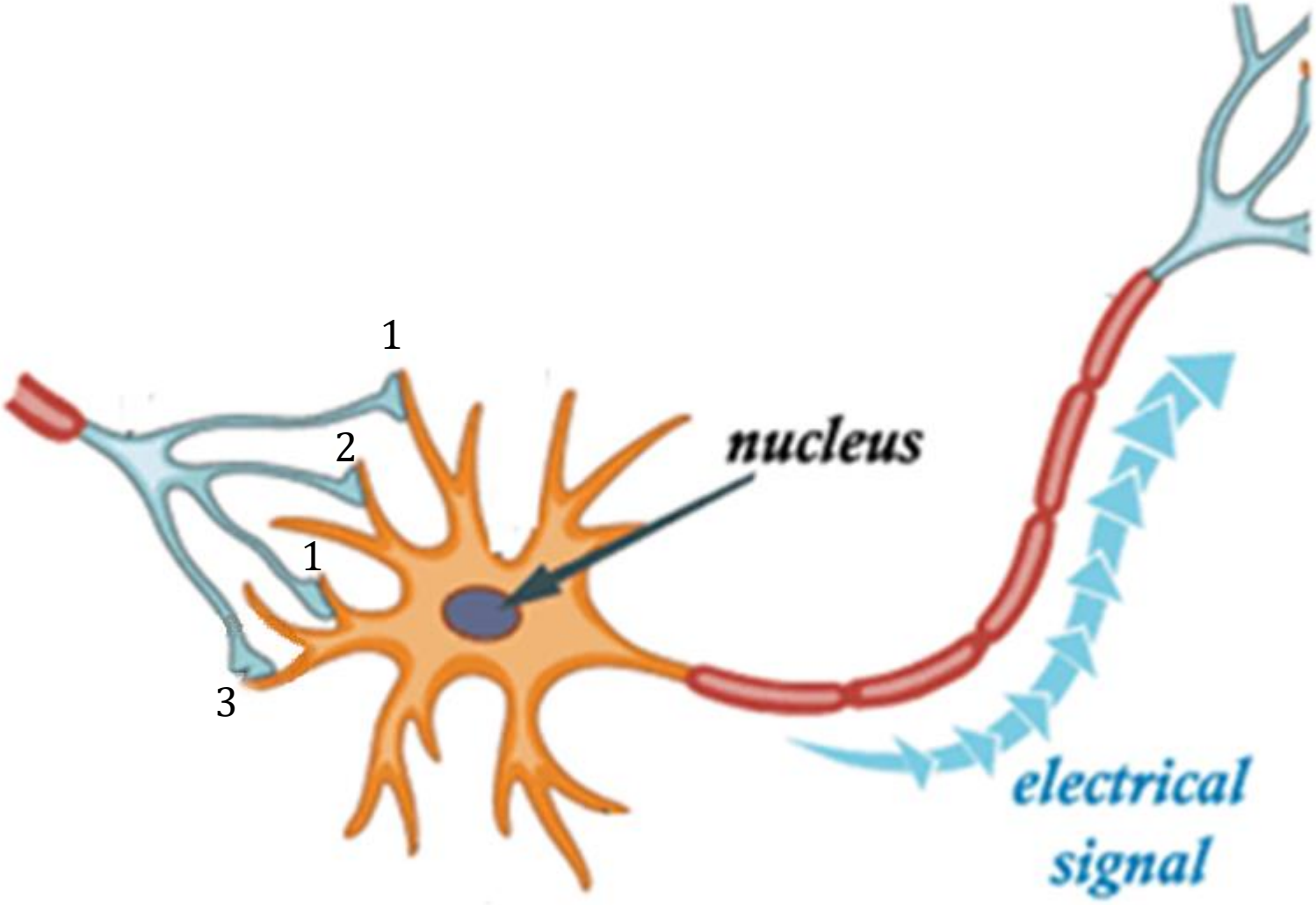
$$h = 1x$$

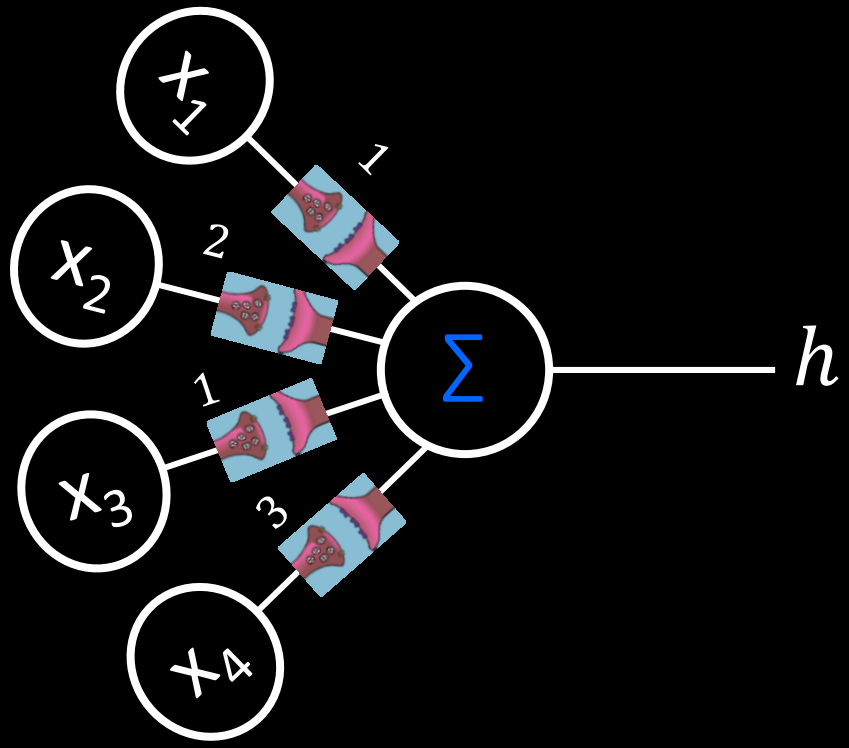


Where is synapse/connection?



Neuron with many inputs





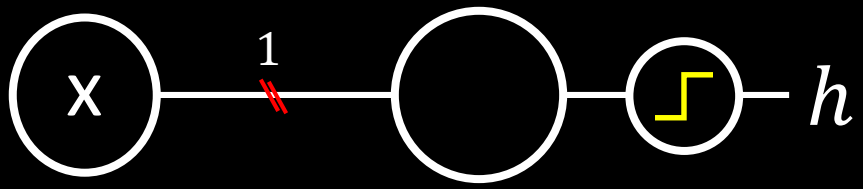
Weighted Sum

$$h = w1 \cdot x1 + w2 \cdot x2 + w3 \cdot x3 + w4 \cdot x4$$

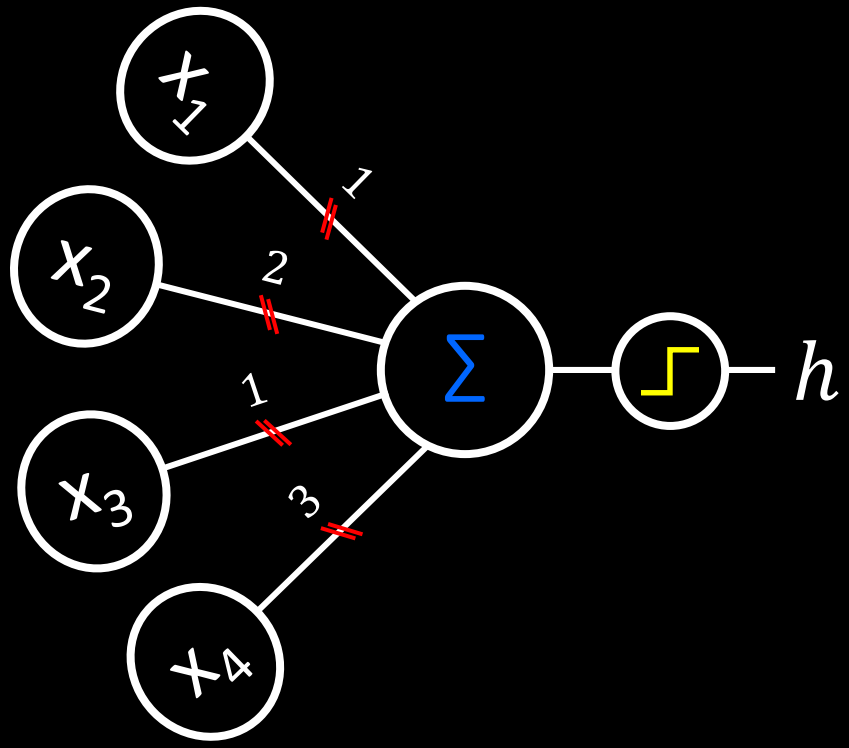
if the inputs are (1,1,1,1), then *h* is ..

Real operation of a neuron

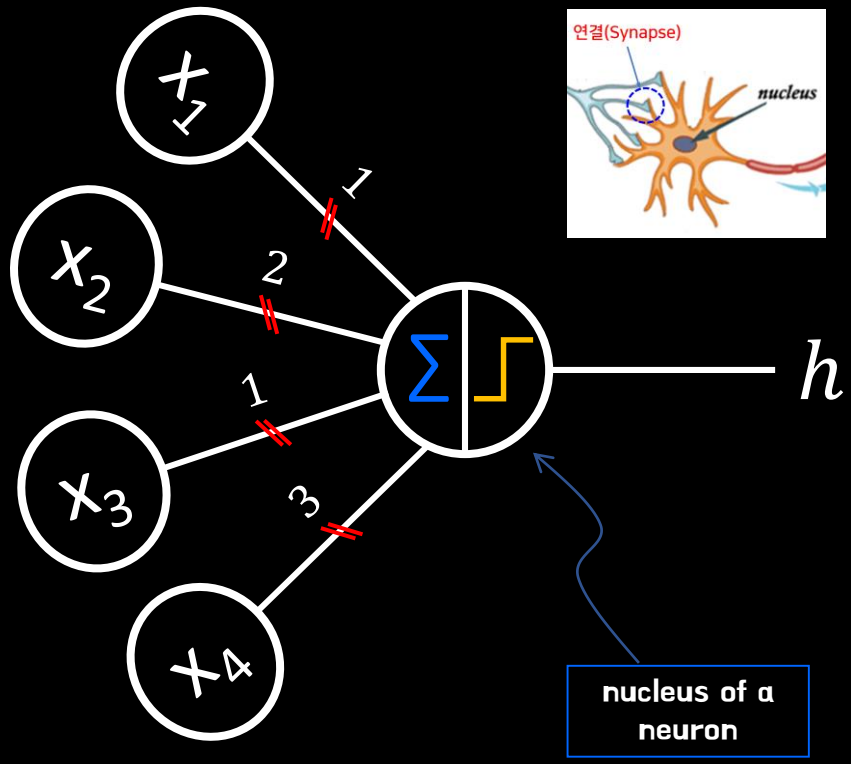
- signal ON if the weighted sum is greater than T
- otherwise signal OFF



Thresholding



Weighted sum and thresholding


x_1
x_2
x_3
x_4
1
2
1
3
h
연결(Synapse)
nucleus
nucleus of a neuron

Drawing neurons

(1) $h = 1x$

(2) $h = x_1 + 2x_2 + x_3 + 3x_4$

(3) $h = \begin{cases} 1 & if\ x_1 + 2x_2 + x_3 + 3x_4 > T \\ 0 & otherwise \end{cases}$

So, what is learning?

How does it learn
automatically?