AI and Deep Learning

Neuron and Learning

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하지만,
연결만 되었다고 되나?
그럼, 어떻게 가능한가?

학습(Learning)

Agenda

- Artificial Intelligence
- Brain and Neurons
- <u>Learning</u>
- Regression
- Deep Neural Networks
- CNN
- RNN
- Unsupervised Learning
- Reinforcement Learning
- AI Applications

Supervised Learning

Learning occurs…

- while experiencing something
- the strength of connection between neurons is properly changed

신기하게도,

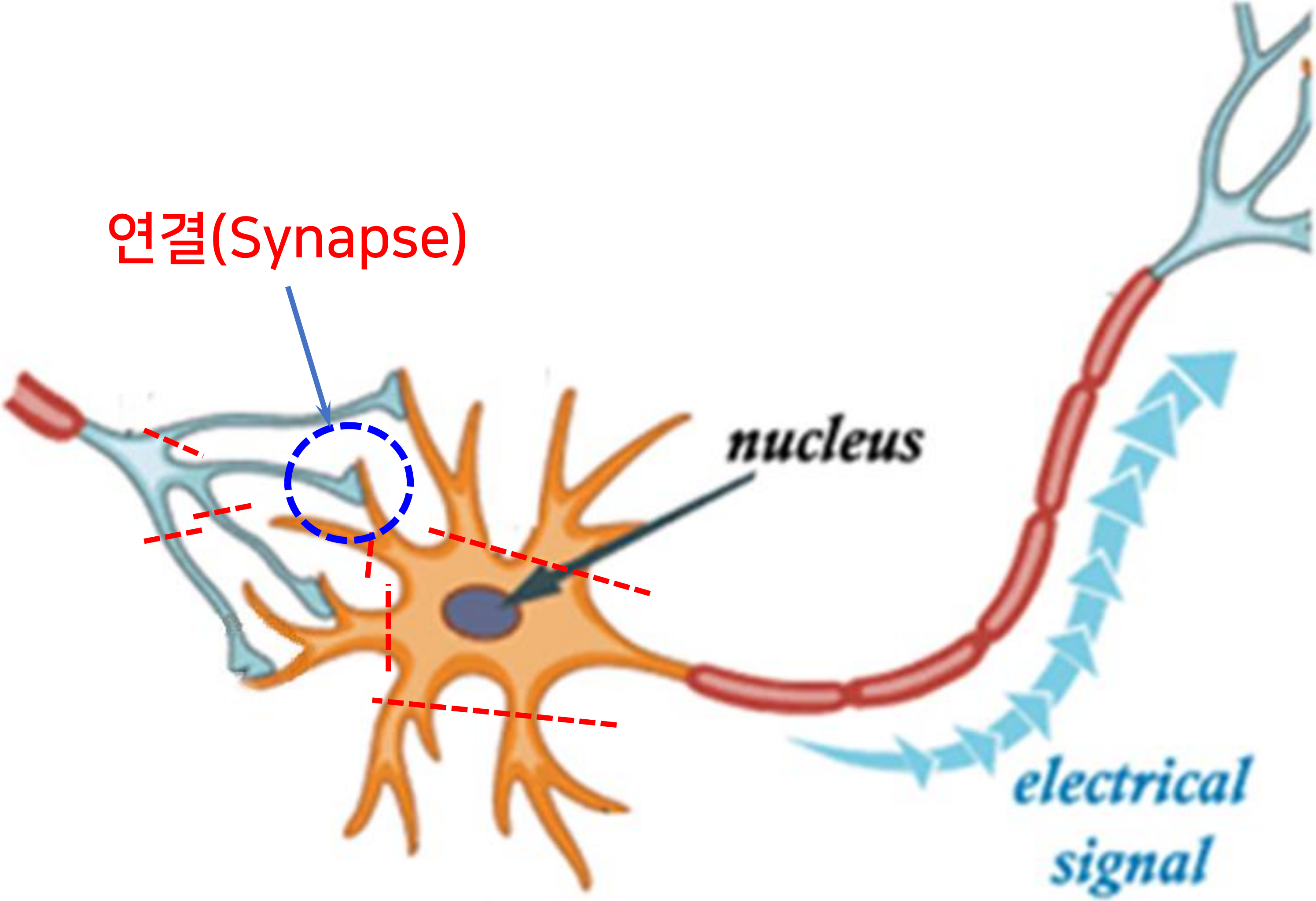
아기는 무엇인가를 경험할 때마다
뉴런 사이의 연결이
‘자동으로‘ 조정된다.

이것이 학습

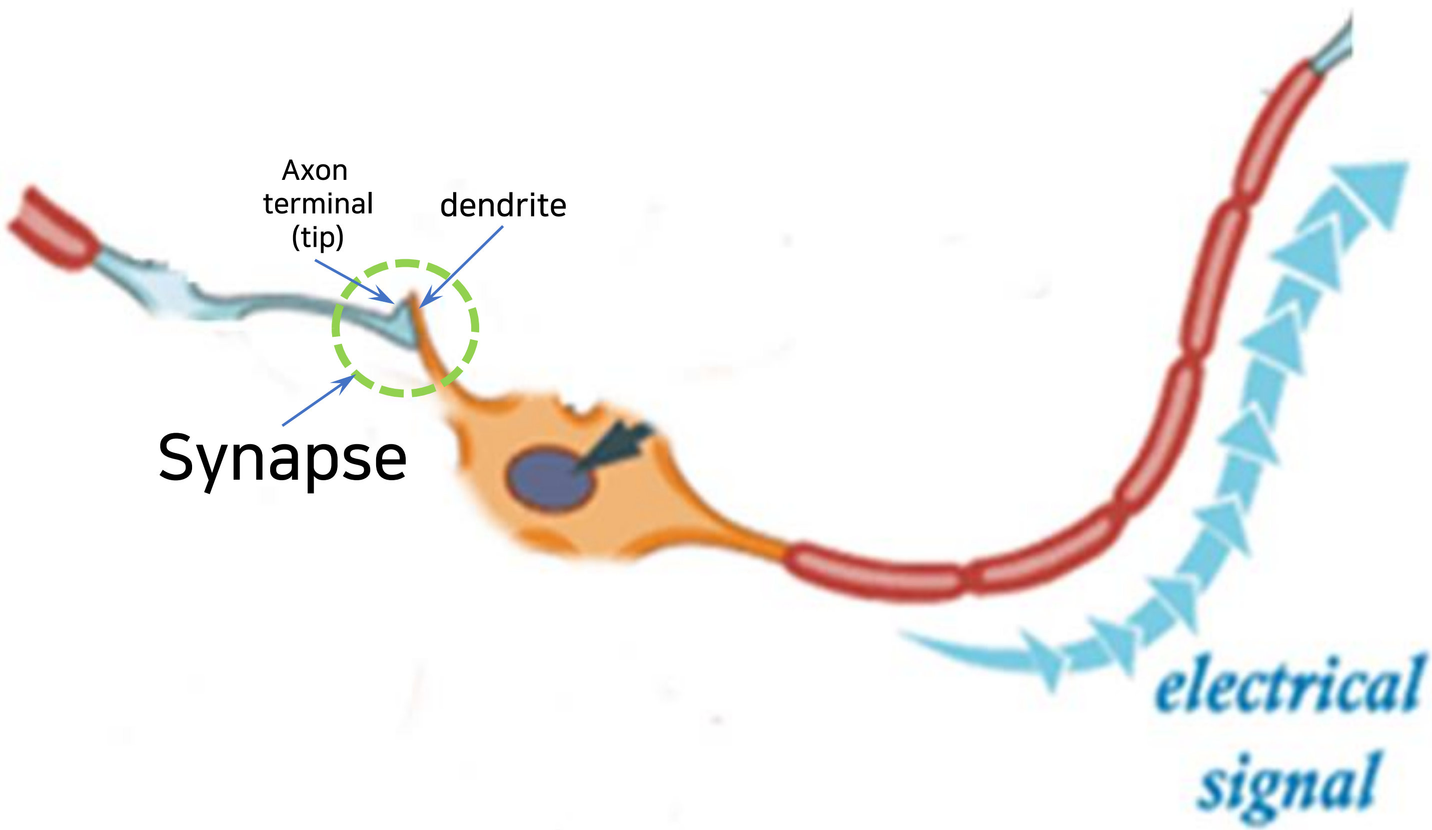
학습 = 연결 값을 조정하는 것

{강하게, 약하게}

두 뉴런의 연결

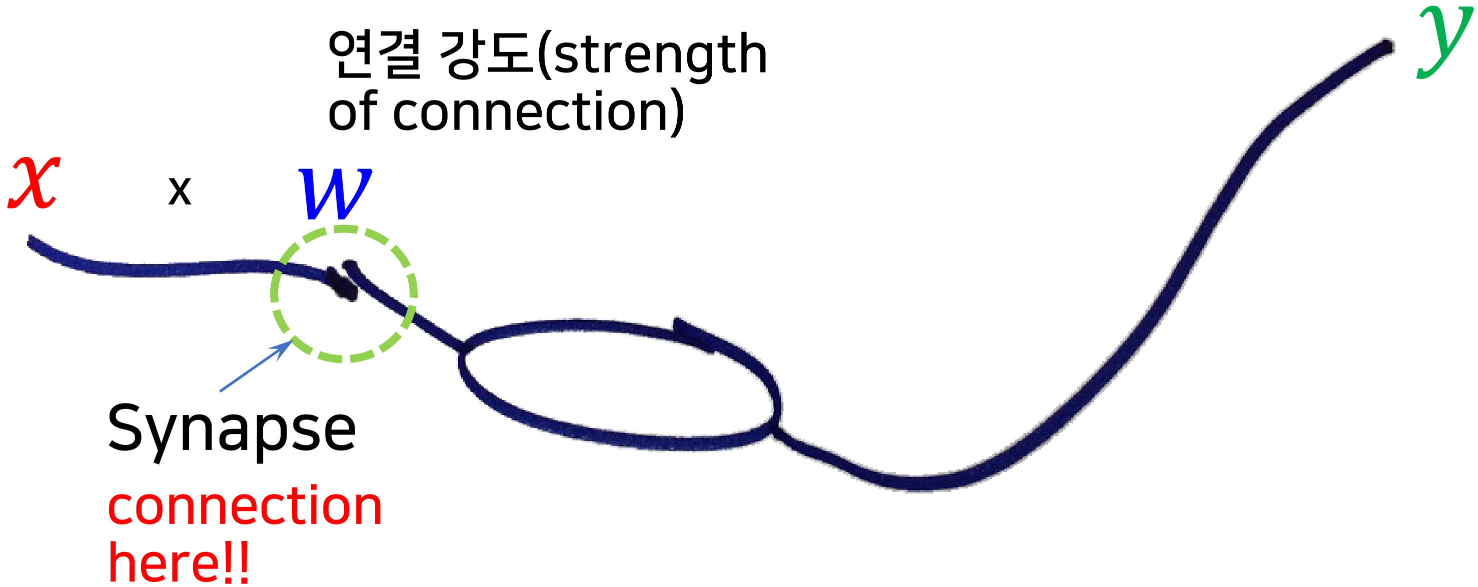


1개 입력을 갖는 뉴런



뉴런의 동작

w: $0, 7, -5$ 등 임의의 값



$$y = wx$$

뉴런의 동작은 매우 단순
입력(x) * 가중치(w)

$$y = wx$$

급료 계산기(응용의 예)

. 1시간(x) 일하면 1USD(y)를 번다고 할 때

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

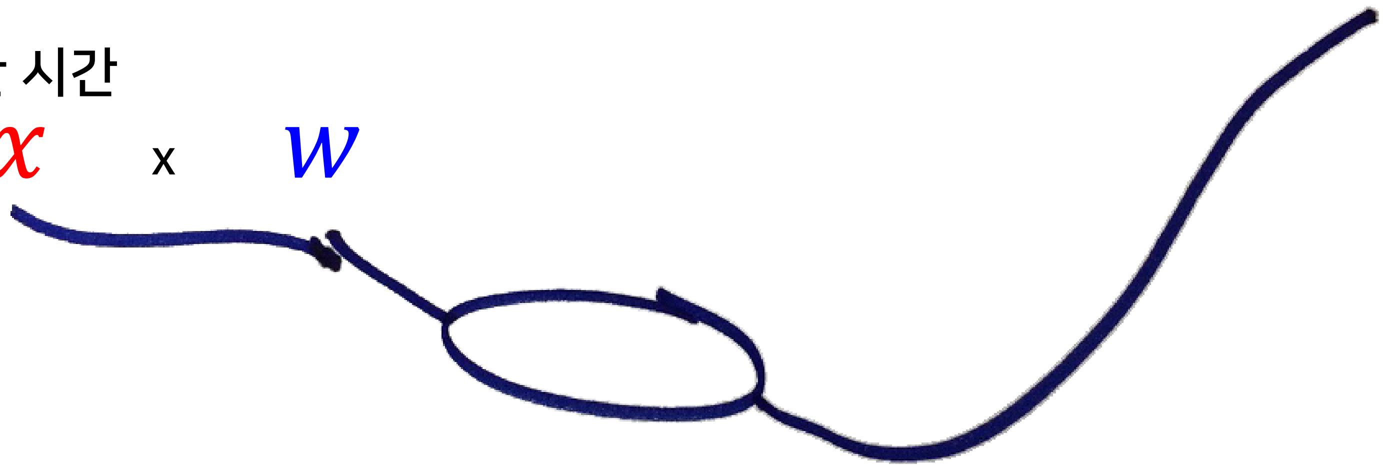
. 이를 위한 w 값을 구하라.

급료

y

일한 시간

x x w



$w = 1$

$y = 1x$

학습이란?

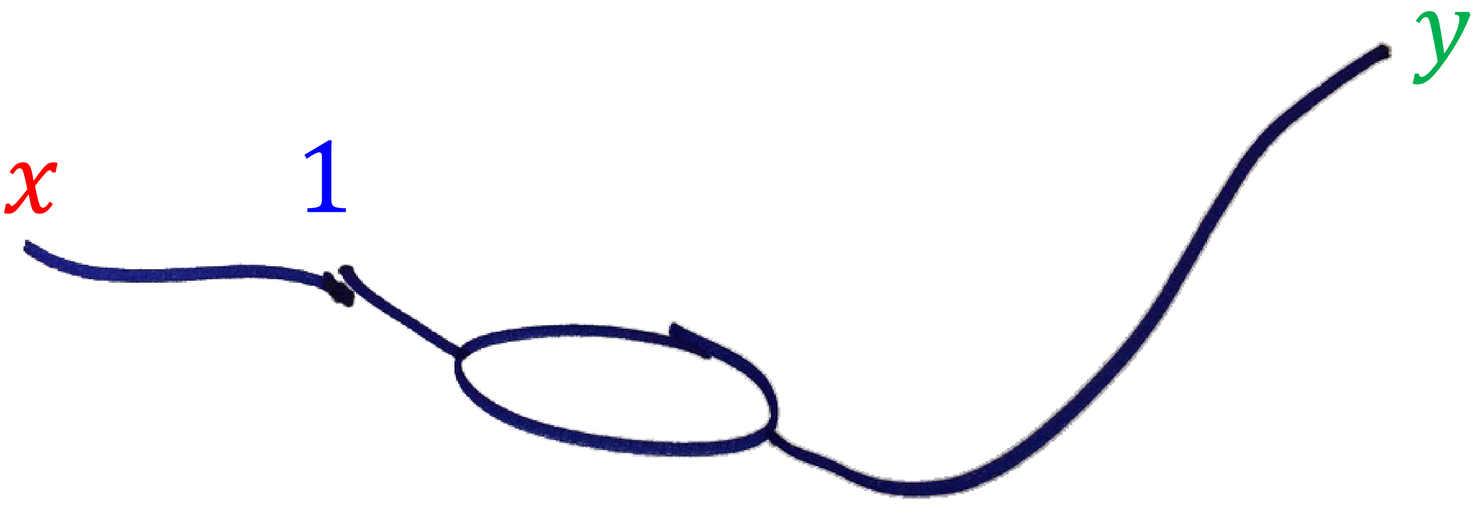
연결 값 w를 조정하는 것

{강하게, 약하게}

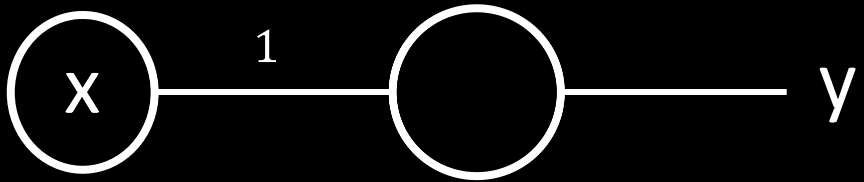
(Q) Draw a neuron

Representing the following equation:

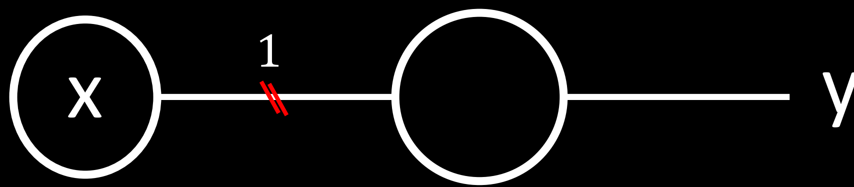
$$y = 1x$$



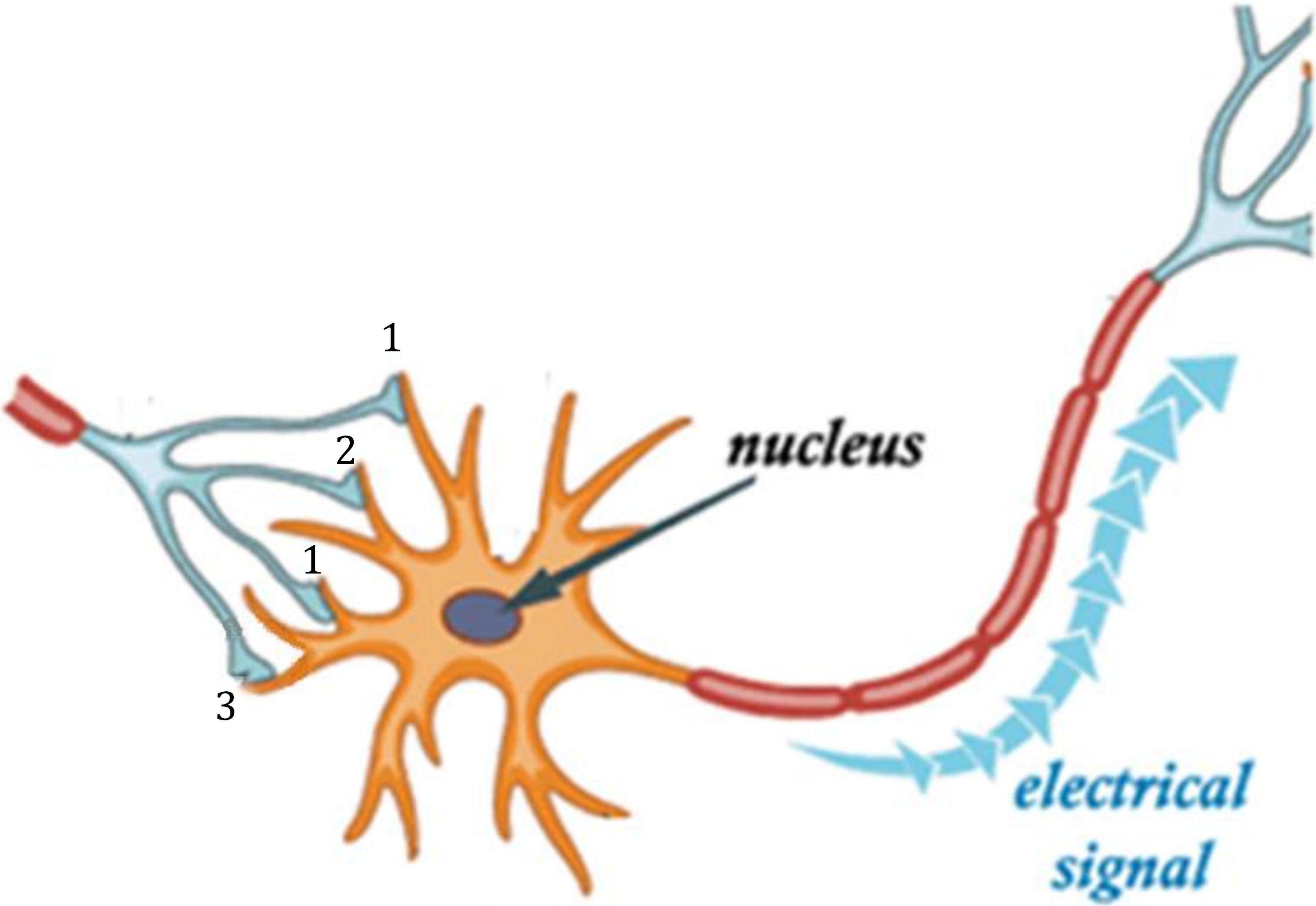
연결(시냅스)은 어디에 있을까?

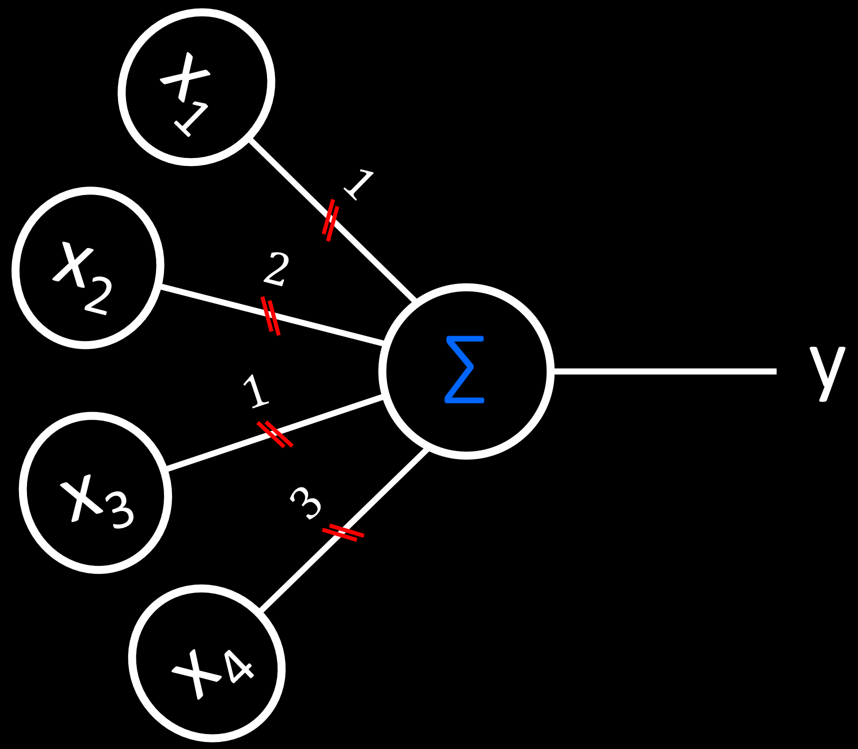


연결(시냅스)은 어디에 있을까?


x
1
y

여러 입력을 갖는 뉴런





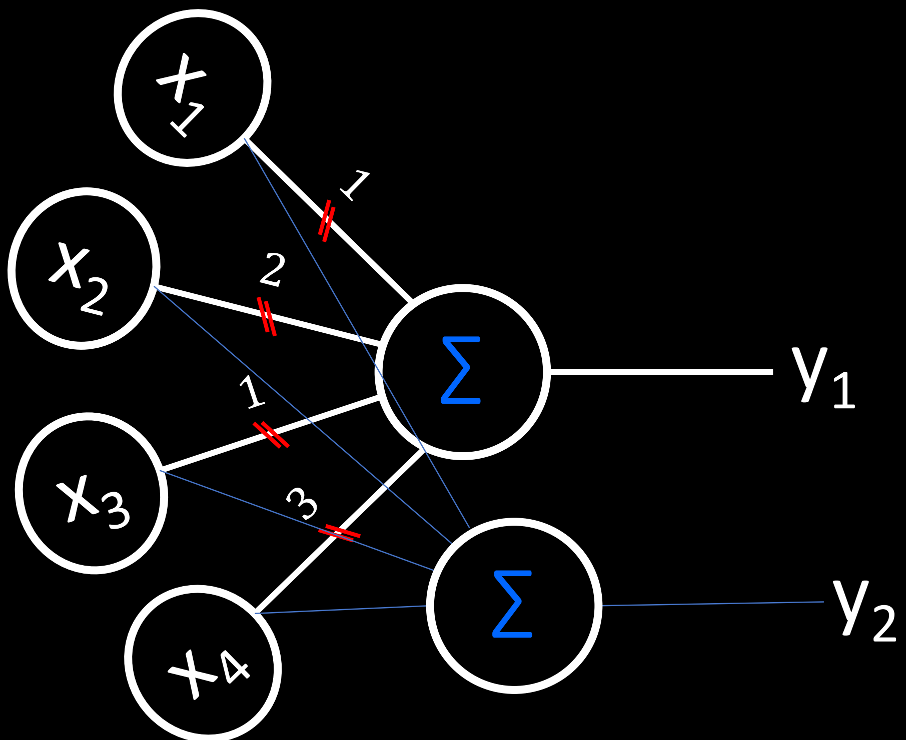
입력에 가중치를 곱하여
모두 더해서 (weighted sum) 출력
(x가 각각 1,1,1,1이면 출력 값은?)

입력의 수만큼 연결이 존재
(Synapses, Weights)

$$\mathrm{y} = \ w1x1 + w2x2 + w3x3 + w4x4$$

$$\mathrm{y} = \ [w1, w2, w3, w4] \begin{bmatrix} x1 \\ x2 \\ x3 \\ x4 \end{bmatrix}$$

$$y = \boldsymbol{wx}$$



x1
x2
x3
x4
1
2
1
3
Σ
Σ
y1
y2

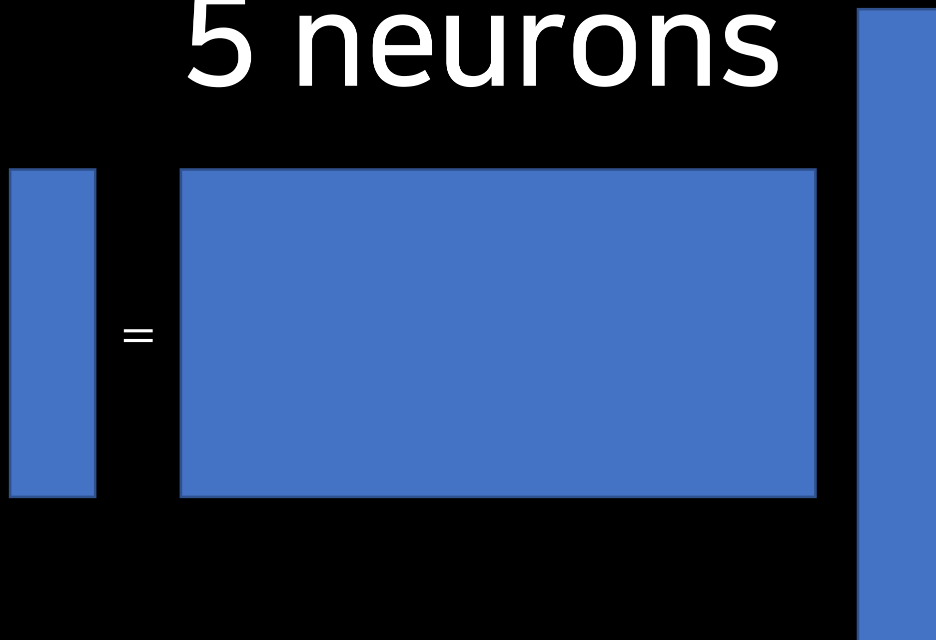
column vector

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} w_1{}^1, w_2{}^1, w_3{}^1, w_4{}^1 \\ w_1{}^2, w_2{}^2, w_3{}^2, w_4{}^2 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \\ x4 \end{bmatrix}$$

matrix

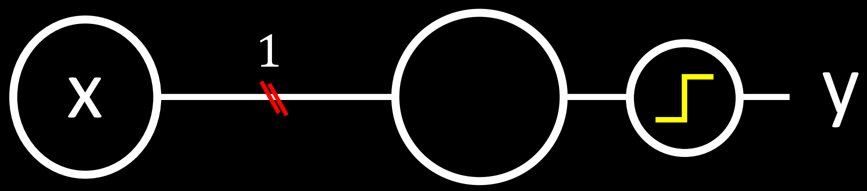
$$\boldsymbol{y} = W\boldsymbol{x}$$

7 inputs
5 neurons

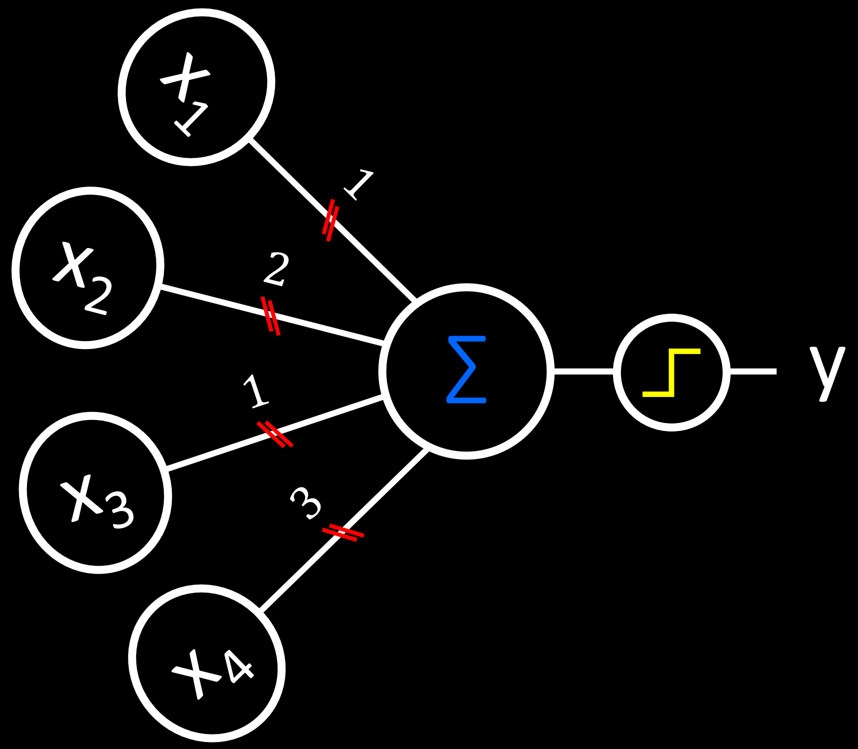


사실은..

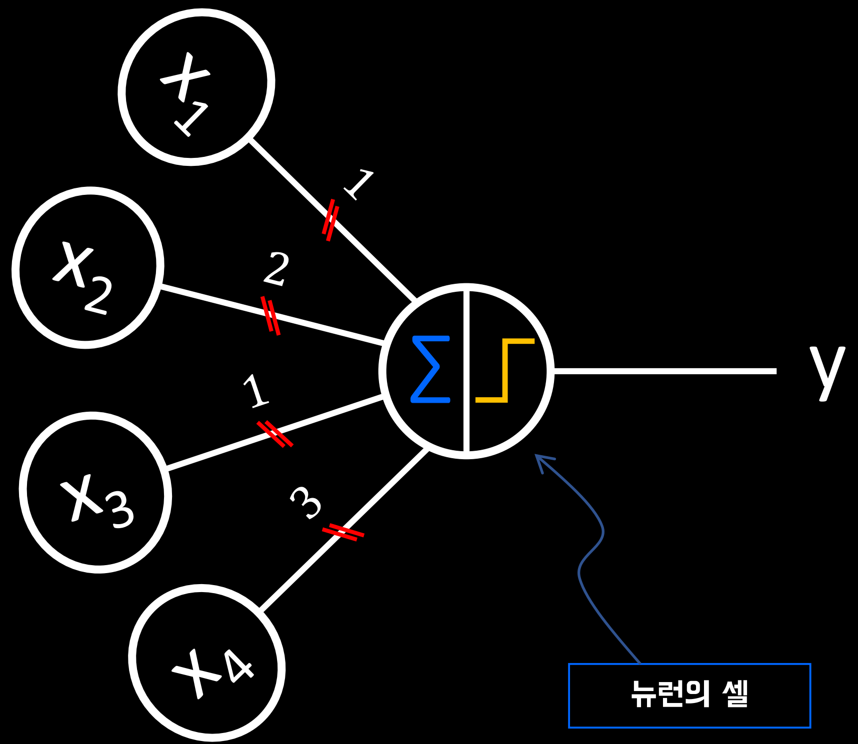
- 뉴런은 모두 더해서(weighted sum) 일정한 값 이상일 때만 시그널 ON
- 그렇지 않으면 시그널 OFF



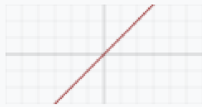
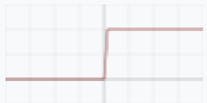
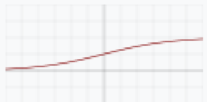
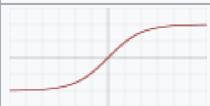
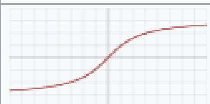
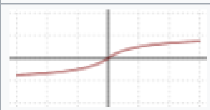
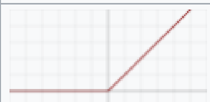
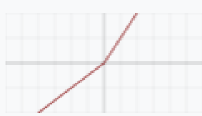
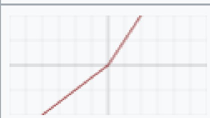
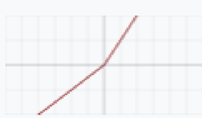
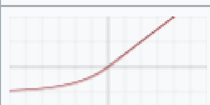
특정 값(T) 이상이면 ON(1),
아니면 OFF(0)



모두 더해서 특정 값(T) 이상이면 ON(1),
아니면 OFF(0)



모두 더해서 특정 값(T) 이상이면 ON(1),
아니면 OFF(0)

Name	Plot	Equation	Derivative (with respect to x)
Identity		$f(x) = x$	$f'(x) = 1$
Binary step		$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{for } x \neq 0 \\ ? & \text{for } x = 0 \end{cases}$
Logistic (a.k.a. Soft step)		$f(x) = \frac{1}{1 + e^{-x}}$	$f'(x) = f(x)(1 - f(x))$
TanH		$f(x) = \tanh(x) = \frac{2}{1 + e^{-2x}} - 1$	$f'(x) = 1 - f(x)^2$
ArcTan		$f(x) = \tan^{-1}(x)$	$f'(x) = \frac{1}{x^2 + 1}$
Softsign [7][8]		$f(x) = \frac{x}{1 + \lvert x \rvert}$	$f'(x) = \frac{1}{(1 + \lvert x \rvert)^2}$
Rectified linear unit (ReLU)[9]		$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$
Leaky rectified linear unit (Leaky ReLU) [10]		$f(x) = \begin{cases} 0.01x & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0.01 & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$
Parametric rectified linear unit (PReLU)[11]		$f(\alpha, x) = \begin{cases} \alpha x & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(\alpha, x) = \begin{cases} \alpha & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$
Randomized leaky rectified linear unit (RReLU)[12]		$f(\alpha, x) = \begin{cases} \alpha x & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$ [1]	$f'(\alpha, x) = \begin{cases} \alpha & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$
Exponential linear unit (ELU)[13]		$f(\alpha, x) = \begin{cases} \alpha(e^x - 1) & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(\alpha, x) = \begin{cases} f(\alpha, x) + \alpha & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$

다음 뉴런을 그려보자.

(1) $y = 1x$

(2) $y = x_1 + 2x_2 + x_3 + 2x_4$

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

요 약

- 뉴런의 연결 부분, 시냅스
- 학습은 연결을 조정하는 것
- 파라미터(W) 튜닝
- 뉴런의 동작
- 뉴런 그리기