

# 인공 신경망

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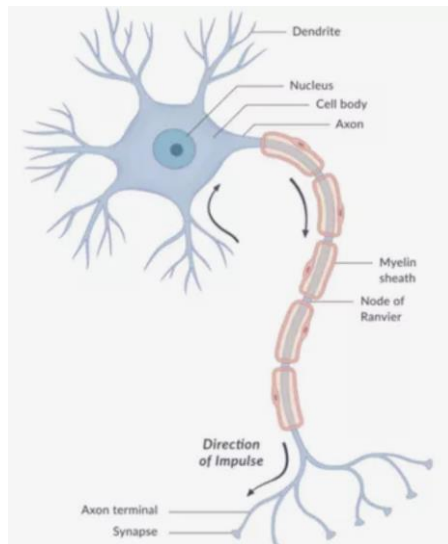
조상구  
경북대학교



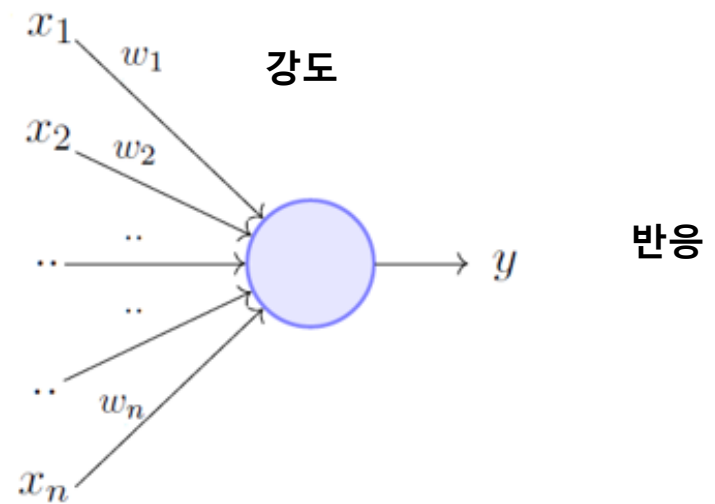
# 뉴론

- 인간의 뉴런과 축삭돌기를 모방한 인공신경망 구조

[뉴런 구조]

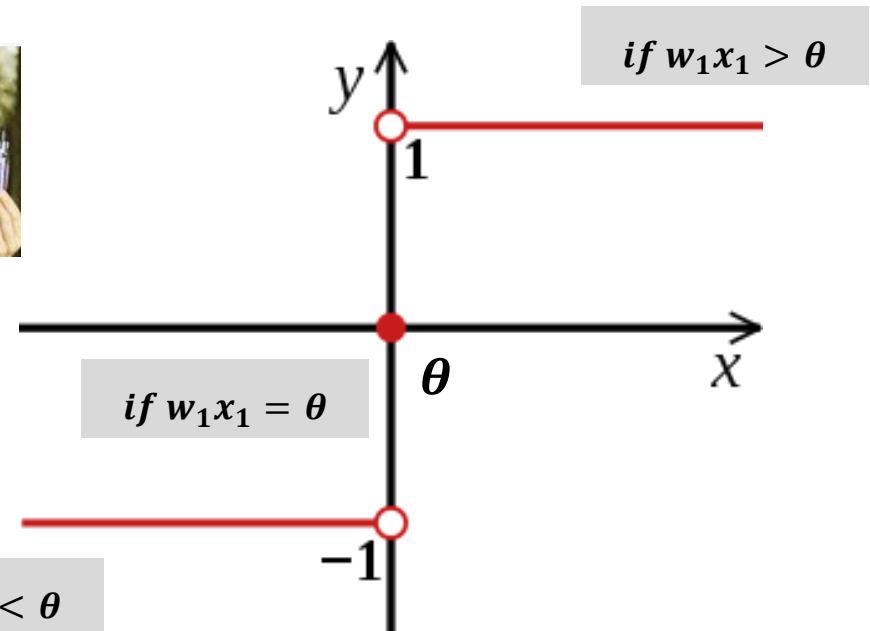
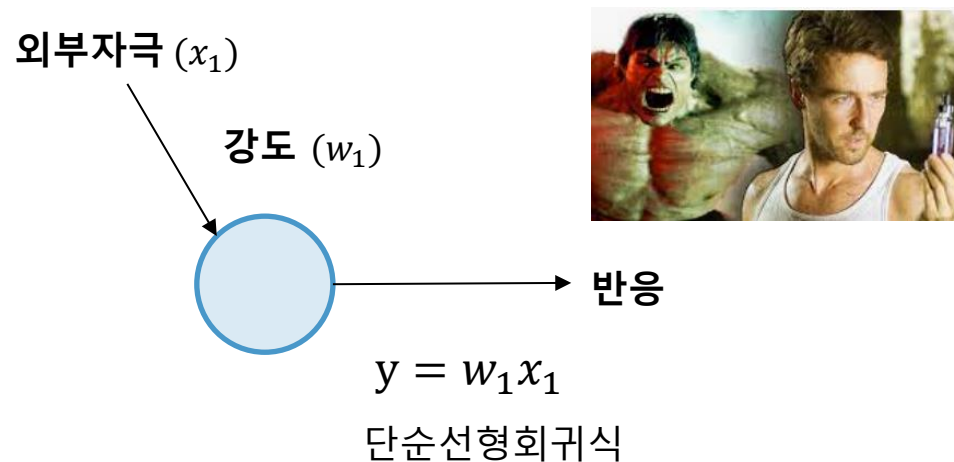


외부자극



# 반응 구조

- 퍼셉트론(perceptron)은 외부자극과 강도의 총합이 특정한 역치(threshold,  $\theta$ )를 넘으면 '1'과 '-1'으로 극단적으로 반응한다고 가정하자



Sign function

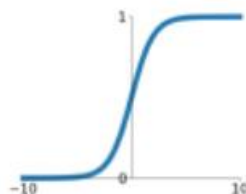
[https://en.wikipedia.org/wiki/Sign\\_function](https://en.wikipedia.org/wiki/Sign_function)

# 반응(Activation) 종류

입력 신호의 총합을 출력신호로 변환하는 **활성화함수(Activation Function)**는 입력 신호의 총합이 활성화, 반응하여 일으키는지 정하는 역할을 수행하는 함수

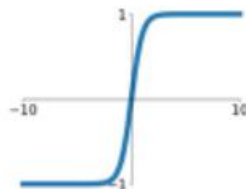
## Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



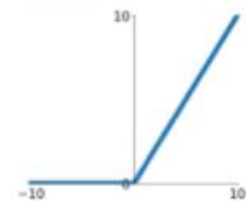
## tanh

$$\tanh(x)$$



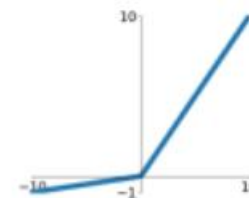
## ReLU

$$\max(0, x)$$



## Leaky ReLU

$$\max(0.1x, x)$$

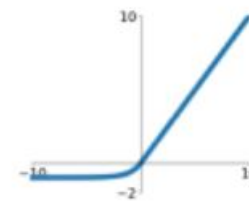


## Maxout

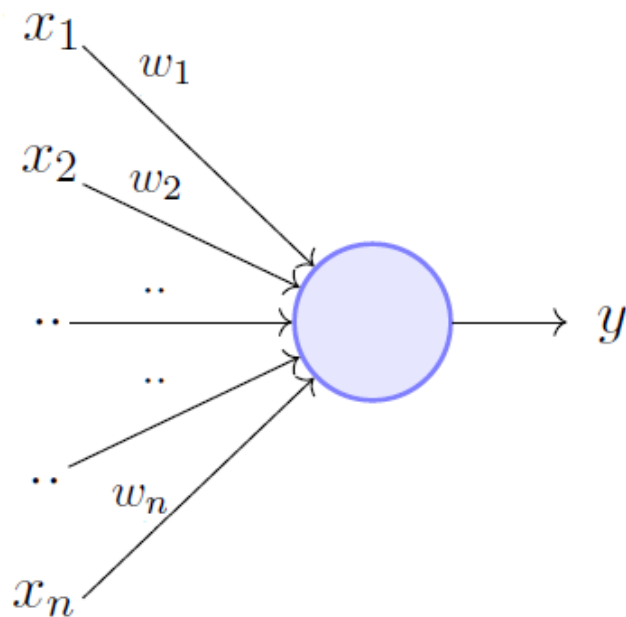
$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

## ELU

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



# 뉴런 구조



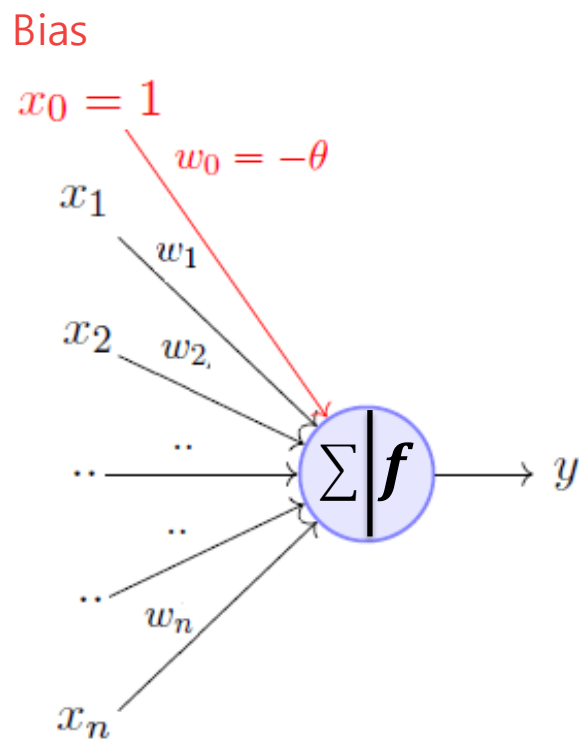
$$y = 1 \quad \text{if} \quad \sum_{i=1}^n w_i * x_i \geq \theta$$
$$= 0 \quad \text{if} \quad \sum_{i=1}^n w_i * x_i < \theta$$

Rewriting the above,

$$y = 1 \quad \text{if} \quad \sum_{i=1}^n w_i * x_i - \theta \geq 0$$
$$= 0 \quad \text{if} \quad \sum_{i=1}^n w_i * x_i - \theta < 0$$

# 뉴런 구조

- 외부자극과 강도의 총합이 특정한 역치(threshold,  $\theta$ )를 넘을지 여부를 외부 Bias( $w_0 = \theta, x_0 = 0$ )의 수식으로 표현한다.



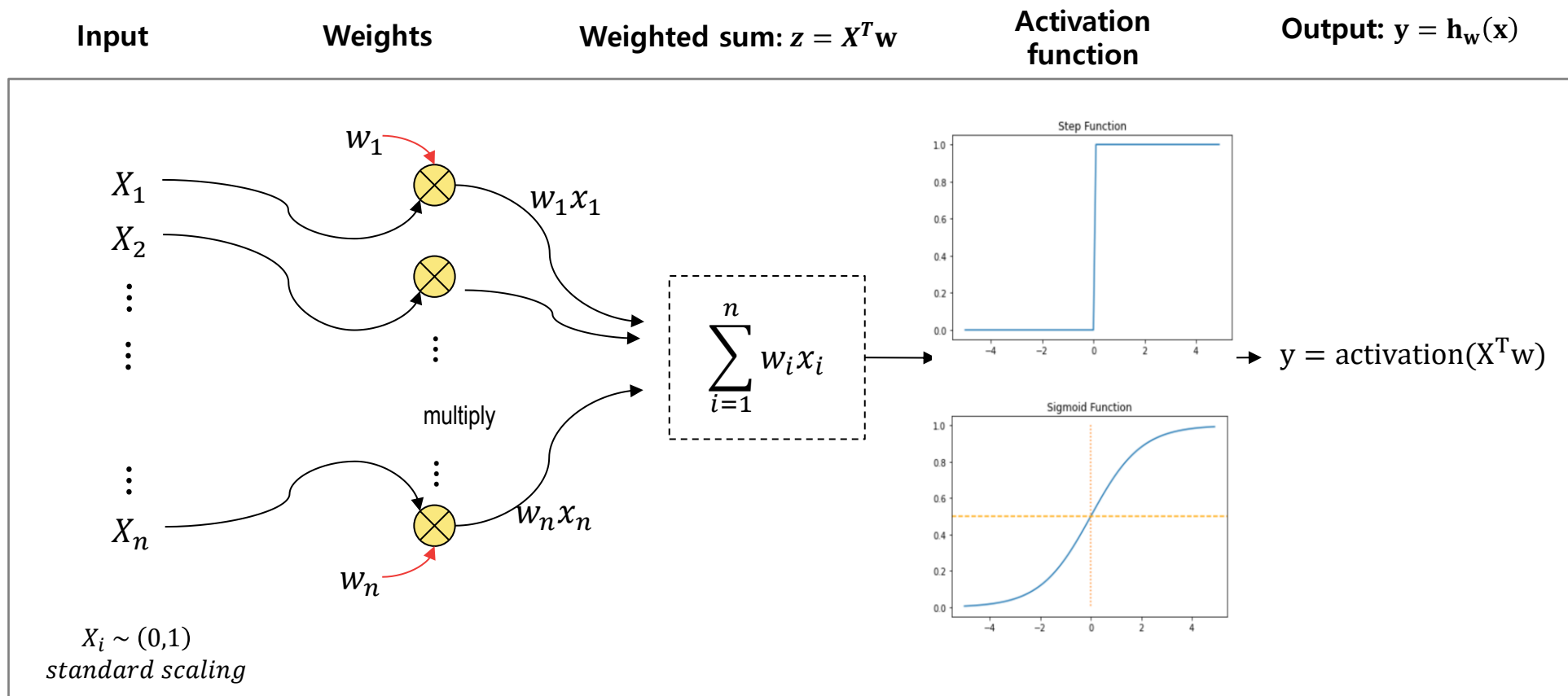
$f$  (활성화함수)

$$y = 1 \quad \text{if} \quad \sum_{i=0}^n w_i * x_i \geq 0$$
$$= 0 \quad \text{if} \quad \sum_{i=0}^n w_i * x_i < 0$$

where,  $x_0 = 1$  and  $w_0 = -\theta$

# 단일 뉴런의 수학적 구조

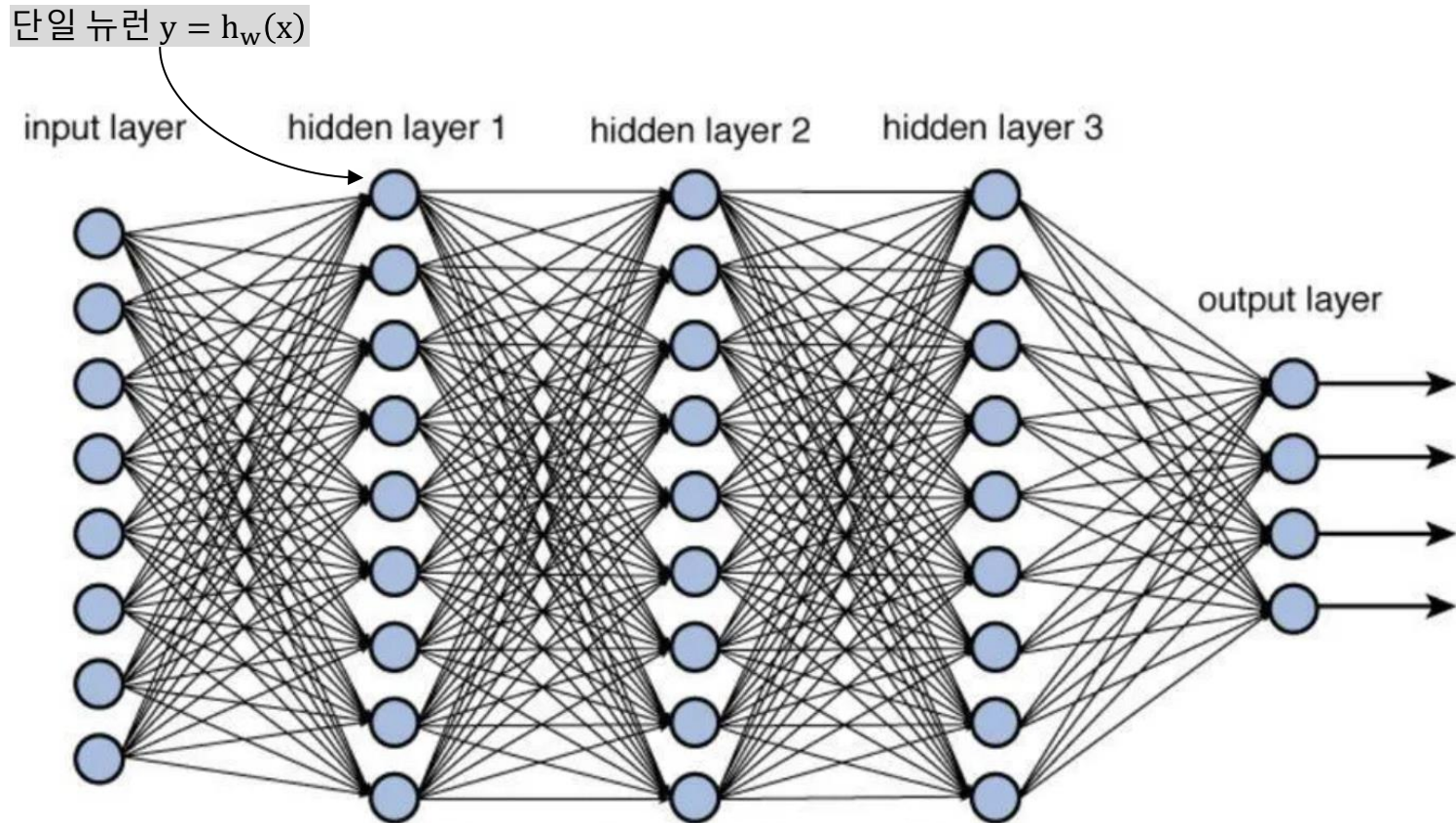
- 단일 뉴런의 수학적식은 다중회귀분석의 함수식과 동일하다





## 다중 뉴런 구조

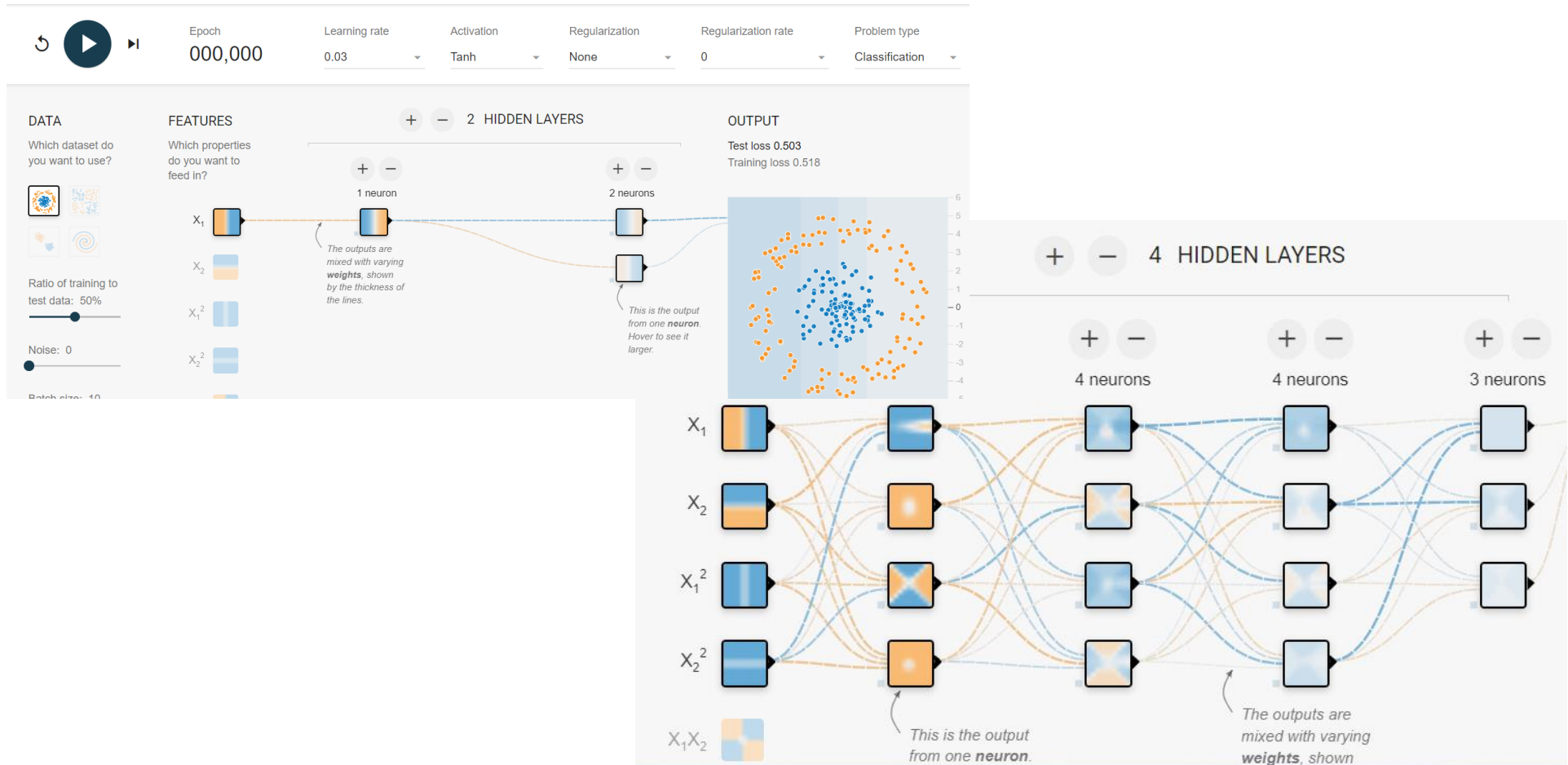
- 여러 개의 단일 뉴런(perceptron)을 다중 Layer로 겹겹이 쌓고 연결하여 네트워크를 구성한 것이 Deep Network Architecture with multiple layers





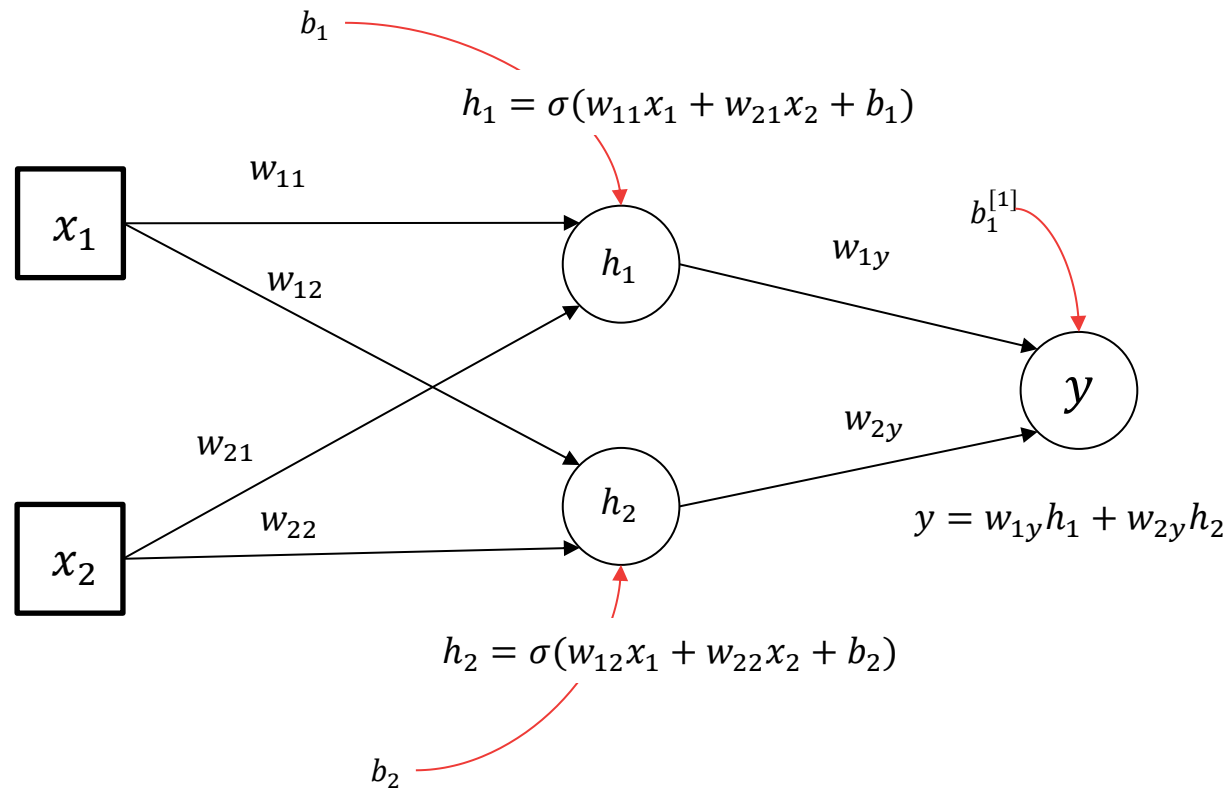
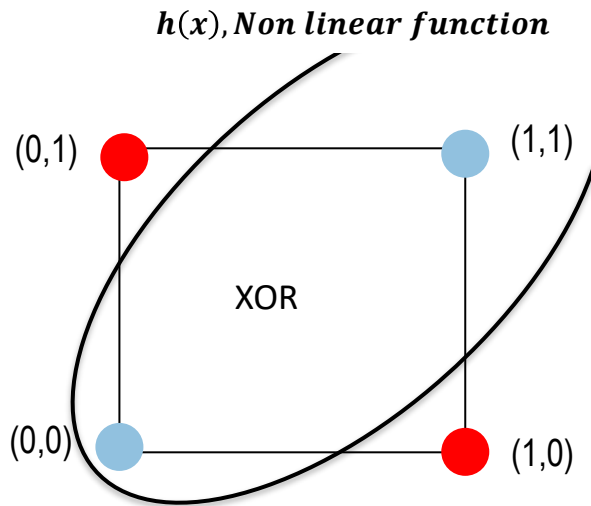
# Tensorflow Neural Network

<https://playground.tensorflow.org>



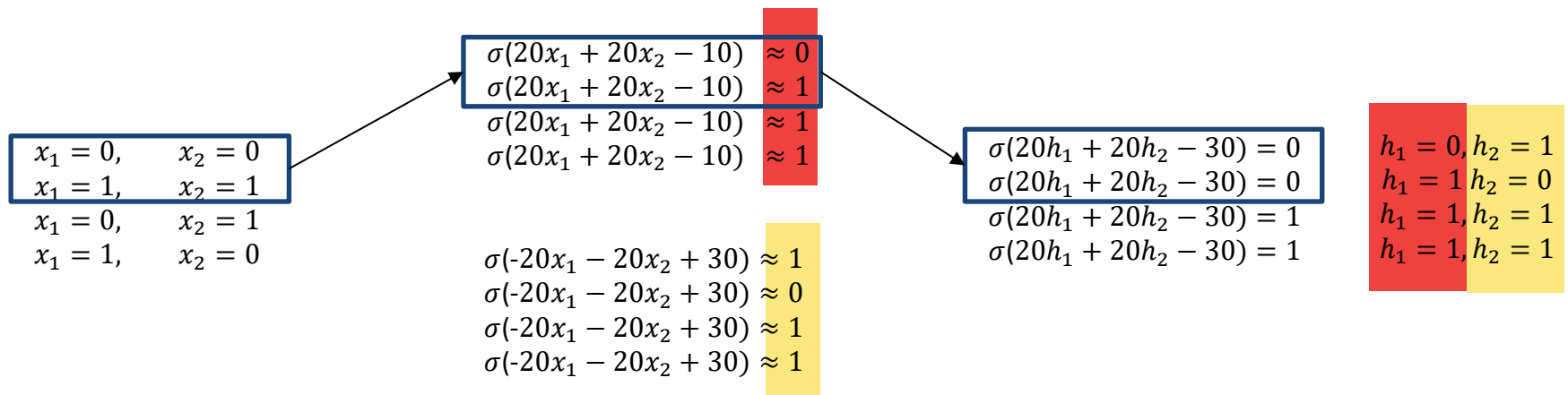
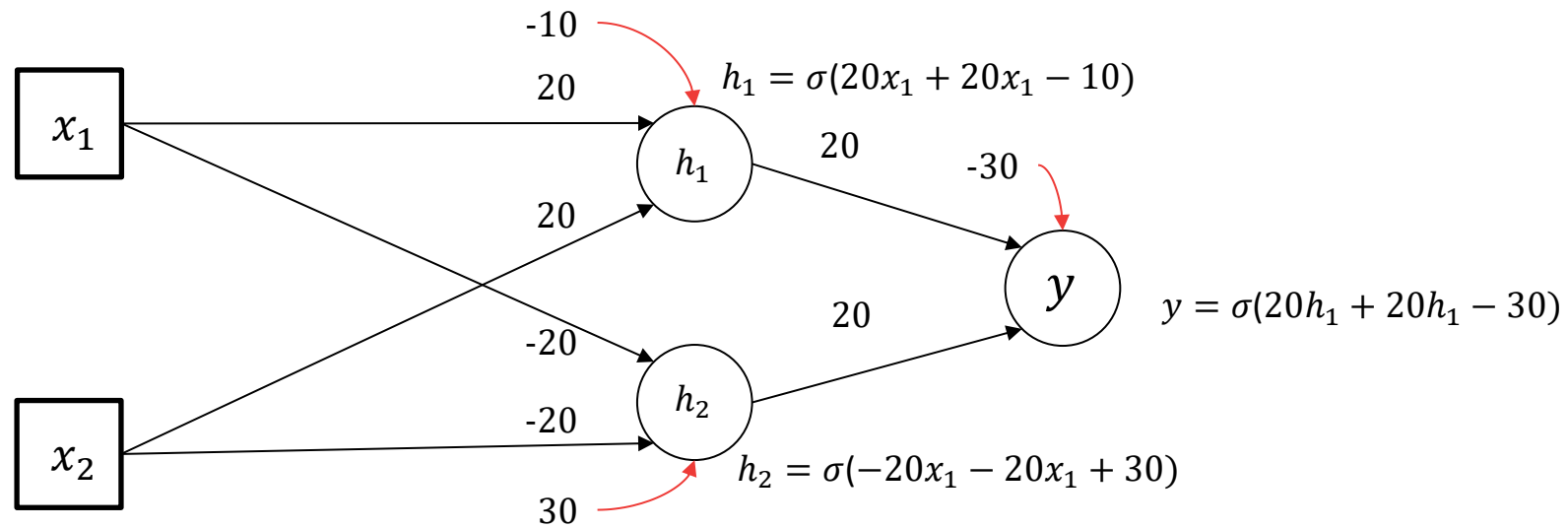
# Neural network

## XOR problem solving



# Neural network XOR problem solving

## Rule based problem solving

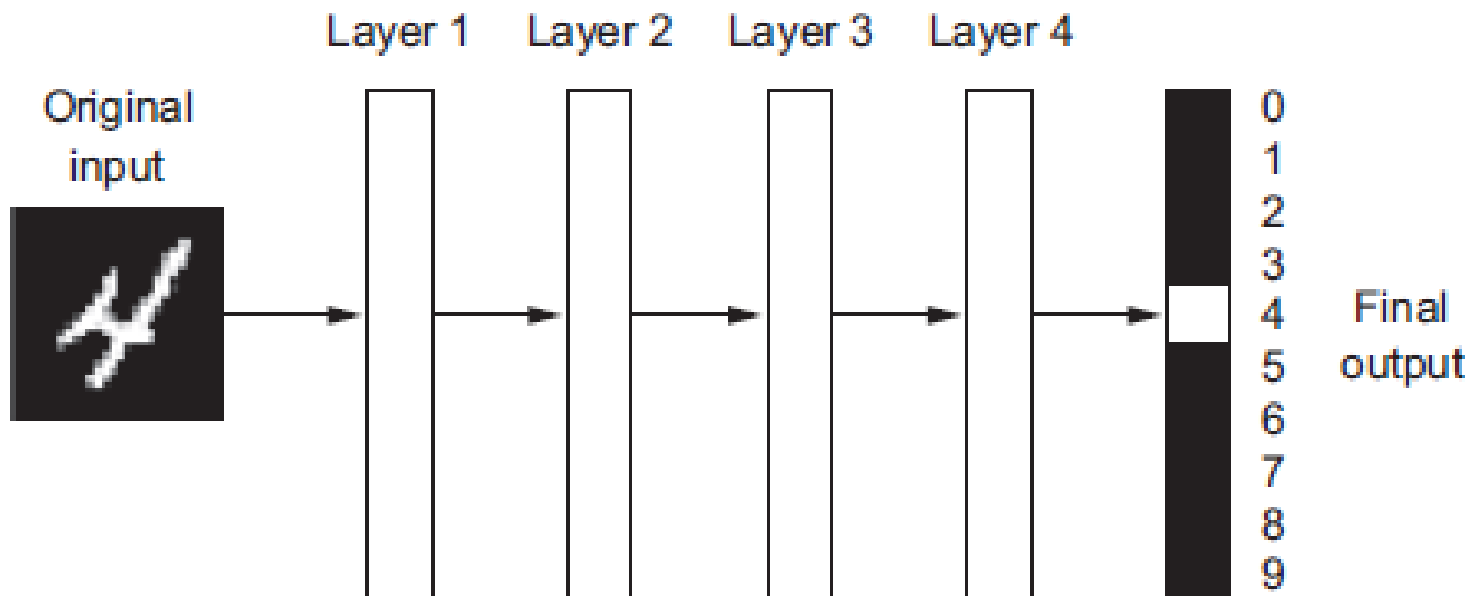


## Neural network

### Deep representations

- MNIST 수기체 '4'의 이미지가 여러 층(layers)에 따라 이미지는 변환(representation)하는 방법

[ A deep neural network for digit classification ]



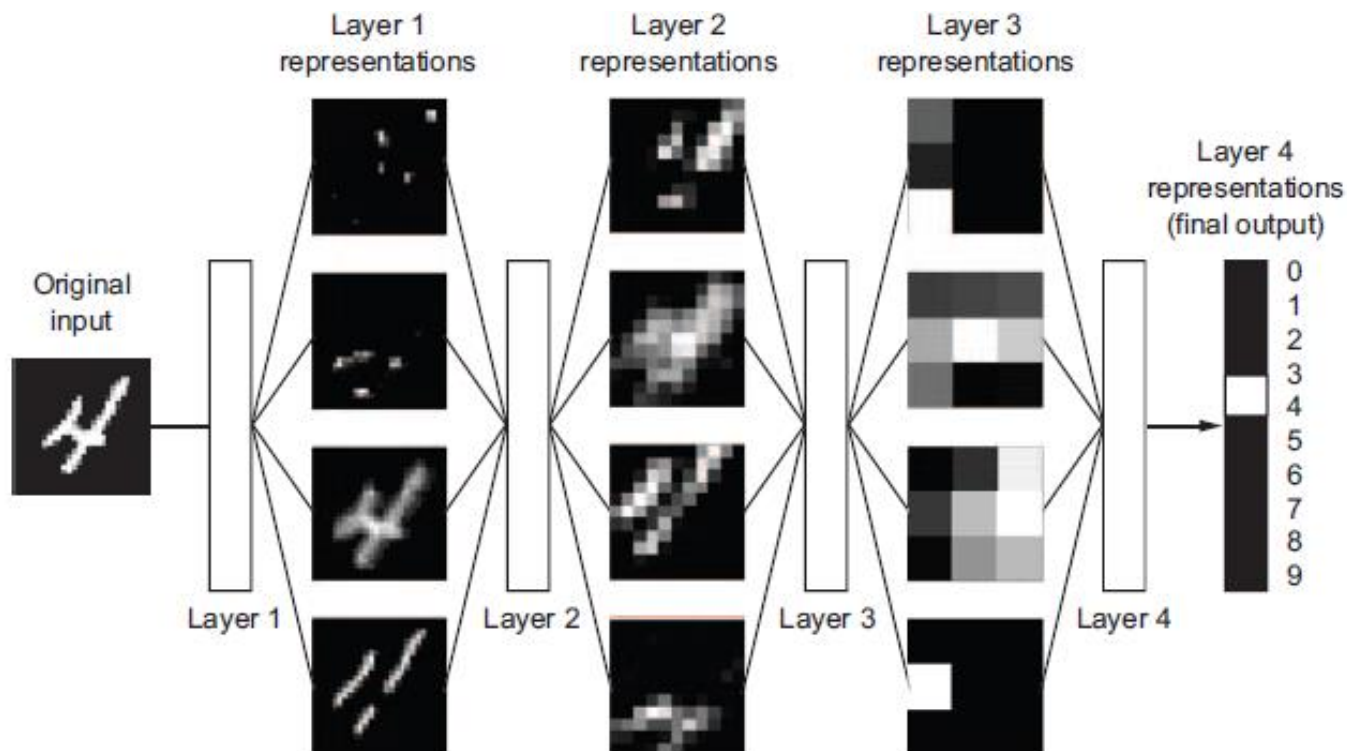
Deep Learning with Python, Francois Chollet, O'RELLY

## Neural network

### Deep representations

- 딥러닝 네트워크는 여러 층(layers)에 따라 숫자 이미지를 표현(representation)으로 변환
- 다단계로 확인하면 원본이미지가 연속적인 필터를 거쳐 증류 작업처럼 점점 더 정제 (purification)

[ A deep representations learned by a digit-classification model]



Deep Learning with Python, Francois Chollet, O'RELLY