Perceptron

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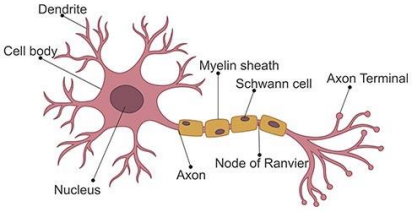
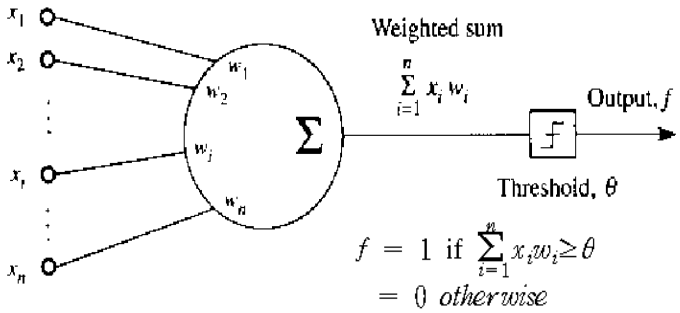
Contents

Perceptron이란?

- Neuron을 모사

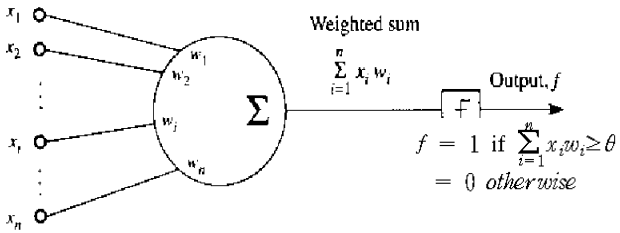


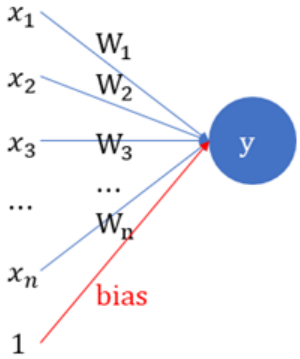
입력 → 강도 → 합 → 변환 → 출력



Perceptron의 구성

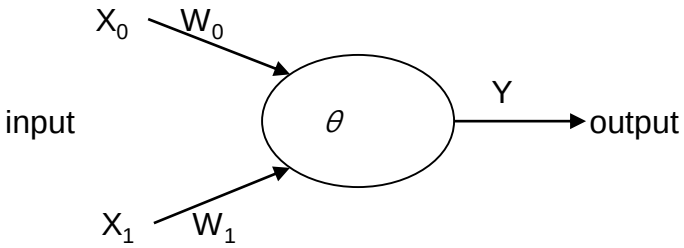
- 입력값
- 가중치
- 출력값: 계단함수를 활성화 함수로 사용





AND Gate by perceptron

– AND Gate



input		output
X_0	X_1	AND
0	0	0
0	1	0
1	0	0
1	1	1

- AND

$$
\begin{aligned}
0\times W_0 + 0\times W_1 = 0 &< \theta \\
0\times W_0 + 1\times W_1 = W_1 &< \theta \\
1\times W_0 + 0\times W_1 = W_0 &< \theta \\
1\times W_0 + 1\times W_1 = W_0 + W_1 &> \theta
\end{aligned}
$$

$$(w_1, w_2, \theta) = (0.5, 0.5, 0.7)$$

NAND Gate

$$(w_1, w_2, \theta) = (-0.5, -0.5, -0.7)$$

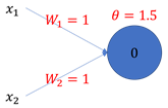
x_1	x_2	y
0	0	1
0	1	1
1	0	1
1	1	0

$$x_1 w_1 (0 \times -0.5) + x_2 w_2 (0 \times -0.5) > -0.7, y = 1$$
$$x_1 w_1 (0 \times -0.5) + x_2 w_2 (1 \times -0.5) > -0.7, y = 1$$
$$x_1 w_1 (1 \times -0.5) + x_2 w_2 (0 \times -0.5) > -0.7, y = 1$$
$$x_1 w_1 (1 \times -0.5) + x_2 w_2 (1 \times -0.5) \leq -0.7, y = 0$$

OR Gate

$$(w_1, w_2, \theta) = (1, 1, 1.5)$$

x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	1



$\therefore W_1 = 1, W_2 = 1, \theta = 1.5$

$$x_1 = 0 \quad x_2 = 1 \quad W_1x_1 + W_2x_2 = 1 \cdot 0 + 1 \cdot 1 = 1 < 1.5 \rightarrow y = 0$$

$$x_1 = 1 \quad x_2 = 0 \quad W_1x_1 + W_2x_2 = 1 \cdot 1 + 1 \cdot 0 = 1 < 1.5 \rightarrow y = 0$$

$$x_1 = 0 \quad x_2 = 0 \quad W_1x_1 + W_2x_2 = 1 \cdot 0 + 1 \cdot 0 = 0 < 1.5 \rightarrow y = 0$$

$$x_1 = 1 \quad x_2 = 1 \quad W_1x_1 + W_2x_2 = 1 \cdot 1 + 1 \cdot 1 = 2 > 1.5 \rightarrow y = 1$$

Simple Implementation

```
def ANDGate(x1, x2):
    w1, w2, theta = 0.5, 0.5, 0.7
    Y = x1*w1+x2*w2
    if Y <= theta:
        return 0
    elif Y > theta:
        return 1
```

[1.1.1] AND Gate

```
ANDGate(0,0)
>> 0
ANDGate(0,1)
>> 0
ANDGate(1,0)
>> 0
ANDGate(1,1)
>> 1
```

[1.1.2] AND Gate 결과

XOR Gate

- XOR

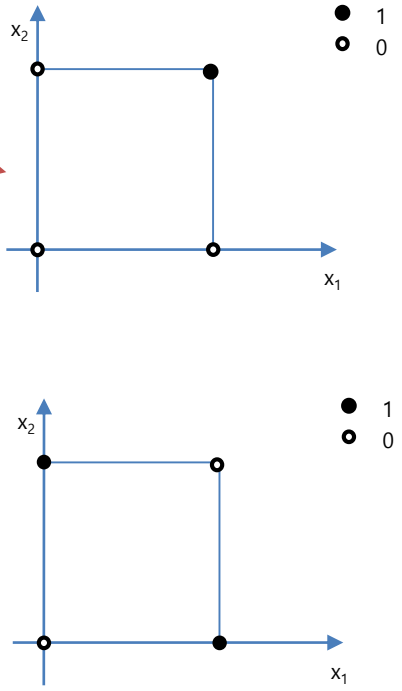
$$
\begin{aligned}
0 \times W_0 + 0 \times W_1 = 0 &\quad < \theta \\
0 \times W_0 + 1 \times W_1 = W_1 &\quad > \theta \\
1 \times W_0 + 0 \times W_1 = W_0 &\quad > \theta \\
1 \times W_0 + 1 \times W_1 = W_0 + W_1 &\quad < \theta
\end{aligned}
$$

→ W_0, W_1 do not exist that satisfy above

→ cannot solve XOR

Why perceptron cannot solve XOR gate problem?

input		Output (by *f*)		
X_0	X_1	AND	OR	XOR
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0



Linearly separable