인공신경망_추가

Artificial Neural Networks

AND

x1	x2	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR

x1	x2	Y
0	0	0
0	1	1
1	0	1
1	1	1

NAND

x1	x2	Y
0	0	1
0	1	1
1	0	1
1	1	0

XOR

x1	x2	h1	h2	Y
0	0	0	1	0
0	1	1	1	1
1	0	1	1	1
1	1	1	0	0

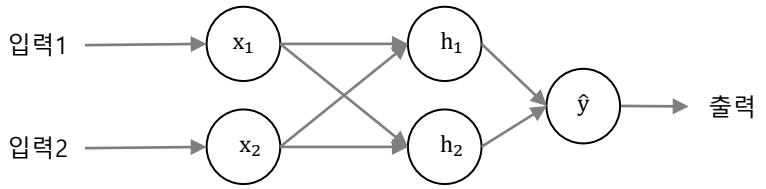
인공신경망

신경망 모형의 기원

신경세포(neuron)의 메커니즘(mechanism)을 관찰하여 이를 표현 할 수 있는 알고리즘을 개발

퍼셉트론(Perceptron) 알고리즘

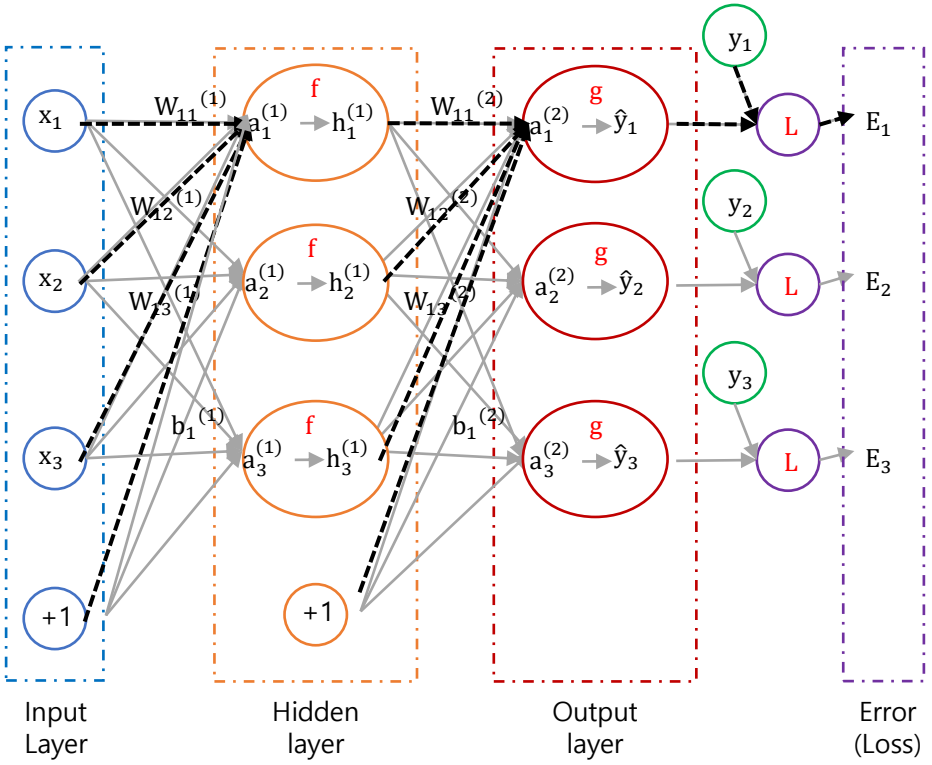
x1	x2	h1	h2	$\hat{y}$
0	0	1	0	0
0	1	1	1	1
1	0	1	1	1
1	1	0	1	0
		NAND	OR	AND



인공신경망

신경망 모형(Neural Network)

신경망 모형의 순전파 과정(Feed forward)



구성요소

- 노드(Node)
- 층(Layer)
  - 입력층(Input layer)
  - 은닉층(Hidden layer)
  - 출력층(Output layer)
- 가중치(Weight) : $W_{ij}^{(k)}$ $k = \{1, \dots, c\}$
- 편향(Bias) : $b_i^{(k)}$
- 가중합(Net) : $a_i^{(k)} = \sum_j W_{ij}^{(k)} h_i^{(k-1)} + b_i^{(k)}$ $(h_i^{(0)} = x_i)$
- 활성화 함수(Activation function) : $f(a_i^{(k)}) = h_i^{(k)}$
- 출력 함수(Output function) : $g(a_i^{(k)}) = \hat{y}_i$
- 손실 함수(Loss function) : $L(\hat{y}_i, y_i) = E_i$
  - $\hat{y}_i$: 추정값, y_i: 실제값

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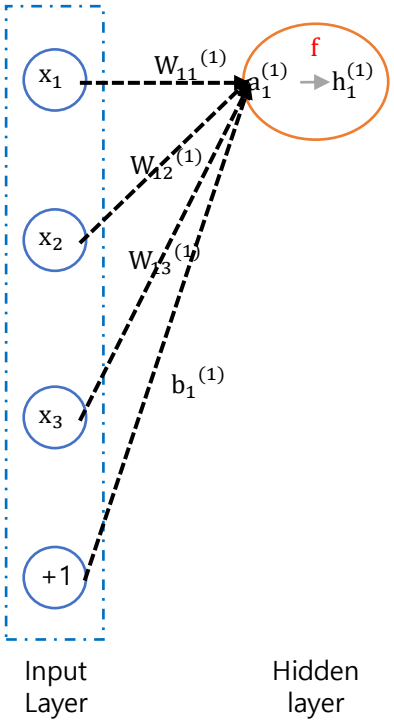


예) $w_{11}^{(1)} = 0.5, w_{12}^{(1)} = 0.2, w_{13}^{(1)} = 0.1, b_1^{(1)} = 0.2$

$$x_1 = 0.5, x_2 = 0.7, x_3 = 0.2$$

$$a_1^{(1)} = 0.5 \times 0.5 + 0.2 \times 0.7 + 0.1 \times 0.2 + 0.2 = 0.61$$

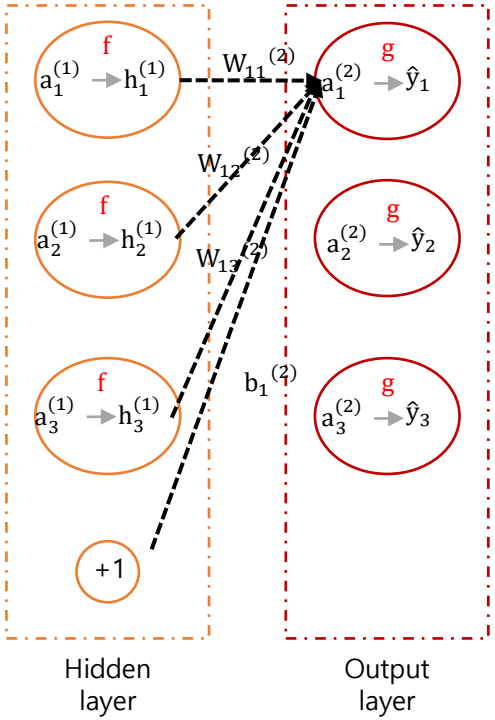
활성화 함수(Activation function) : sigmoid

$$h_1^{(1)} = f\left(a_1^{(1)}\right) = \frac{1}{1 + e^{-a_1^{(1)}}} = \frac{1}{1 + e^{-0.61}} = 0.6479$$

인공신경망

신경망 모형(Neural Network)

신경망 모형의 순전파 과정(Feed forward)



예) $w_{11}^{(2)} = 0.3, w_{12}^{(2)} = 0.3, w_{13}^{(2)} = 0.4, b_1^{(2)} = 0.3$

$$h_1 = 0.65\,, h_2 = 0.38, h_3 = 0.12$$

$$a_1^{(2)} = 0.3 \times 0.65 + 0.3 \times 0.38 + 0.4 \times 0.12 + 0.3 = 0.457$$

같은 방법으로, $a_2^{(2)} = 0.55, a_3^{(2)} = 0.18$

출력함수 (Output function) : softmax

$$e^{0.457} = 1.5793$$

$$e^{0.55} = 1.7332$$

$$e^{0.18} = 1.1972$$

$$\Rightarrow \hat{y}_1 = \frac{1.5793}{1.5793 + 1.7332 + 1.1972} = 0.35$$

$$\hat{y}_2 = 0.38, \hat{y}_3 = 0.27$$

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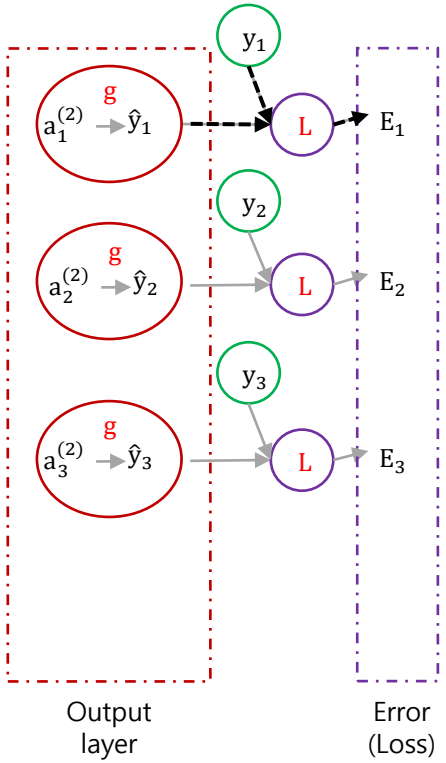
신경망 모형(Neural Network)

신경망 모형의 순전파 과정(Feed forward)



예) $\hat{y}_1 = 0.35, \hat{y}_2 = 0.38, \hat{y}_3 = 0.27$

실제 값이 2번째 범주에 속한다면 $y = (0,1,0)$

손실함수 $L(\hat{y}_i, y_i) = E_i$

- 평균제곱오차 $E_i = \frac{1}{2}\sum(\hat{y} - y_1)^2 = \frac{1}{2}\{(0.35-0)^2 + (0.38-1)^2 + (0.27-0)^2\} = 0.2899$
- 교차엔트로피오차 : $E_i = -\sum y_k \log \hat{y}_k = 0.9675$

실제 값이 3번째 범주에 속한다면 $y = (0,0,1)$

- 평균제곱오차 $E_i = \frac{1}{2}\sum(\hat{y} - y_1)^2 = \frac{1}{2}\{(0.35-0)^2 + (0.38-0)^2 + (0.27-1)^2\} = 0.3999$
- 교차엔트로피오차 : $E_i = -\sum y_k \log \hat{y}_k = 1.3093$