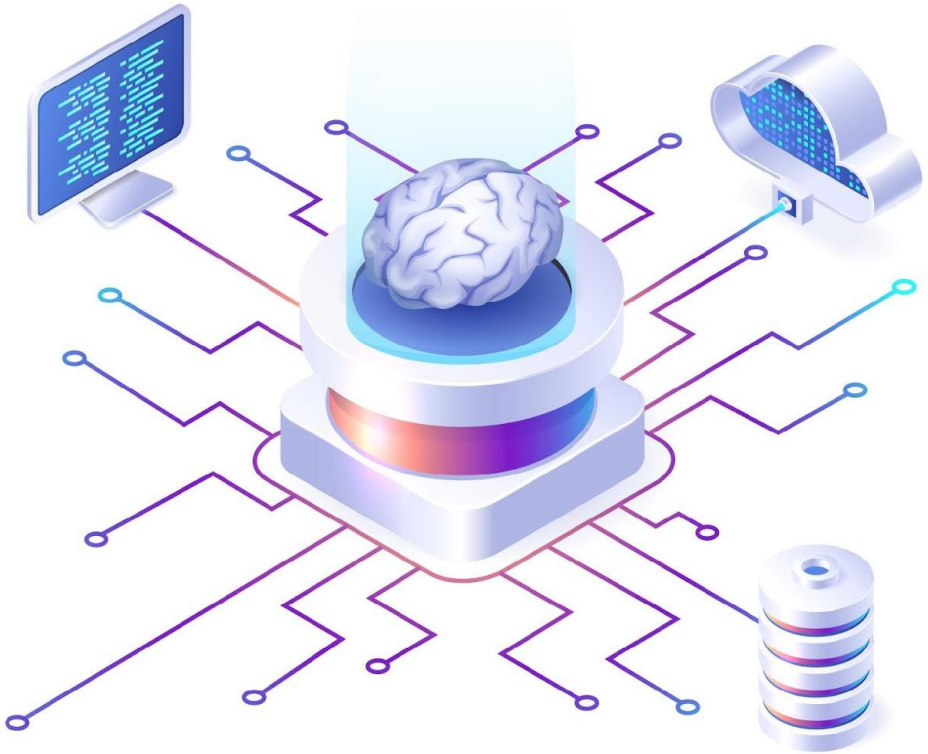
Insight campus SeSAC

딥러닝 기초

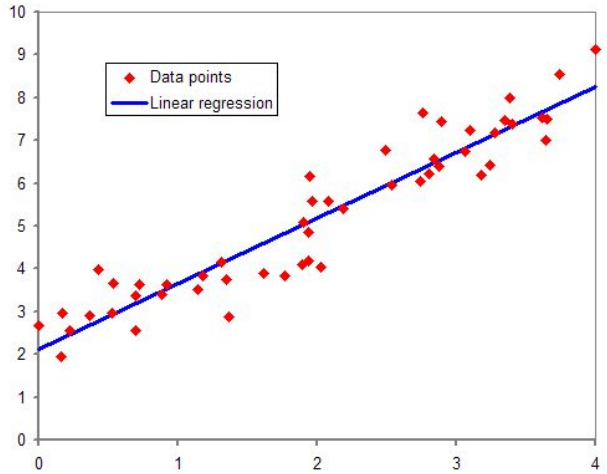
실무형 인공지능 자연어처리



선형 회귀 (Linear regression)

Y 연속형 : 입력변수(X)의 선형결합으로 출력변수(Y)를 표현

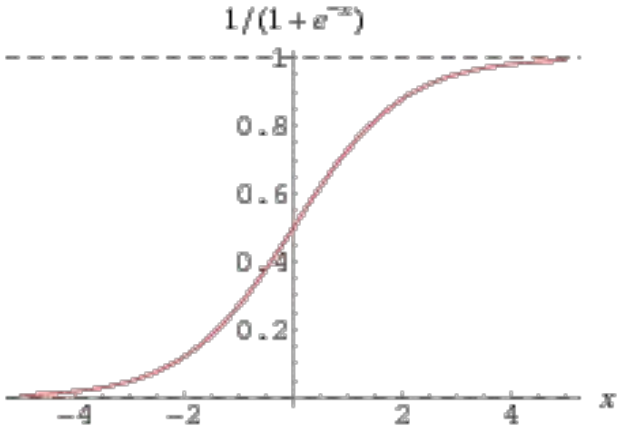
$$f(X) = w_0 + w_1 X_1 + w_2 X_2 + \ldots + w_n X_n$$



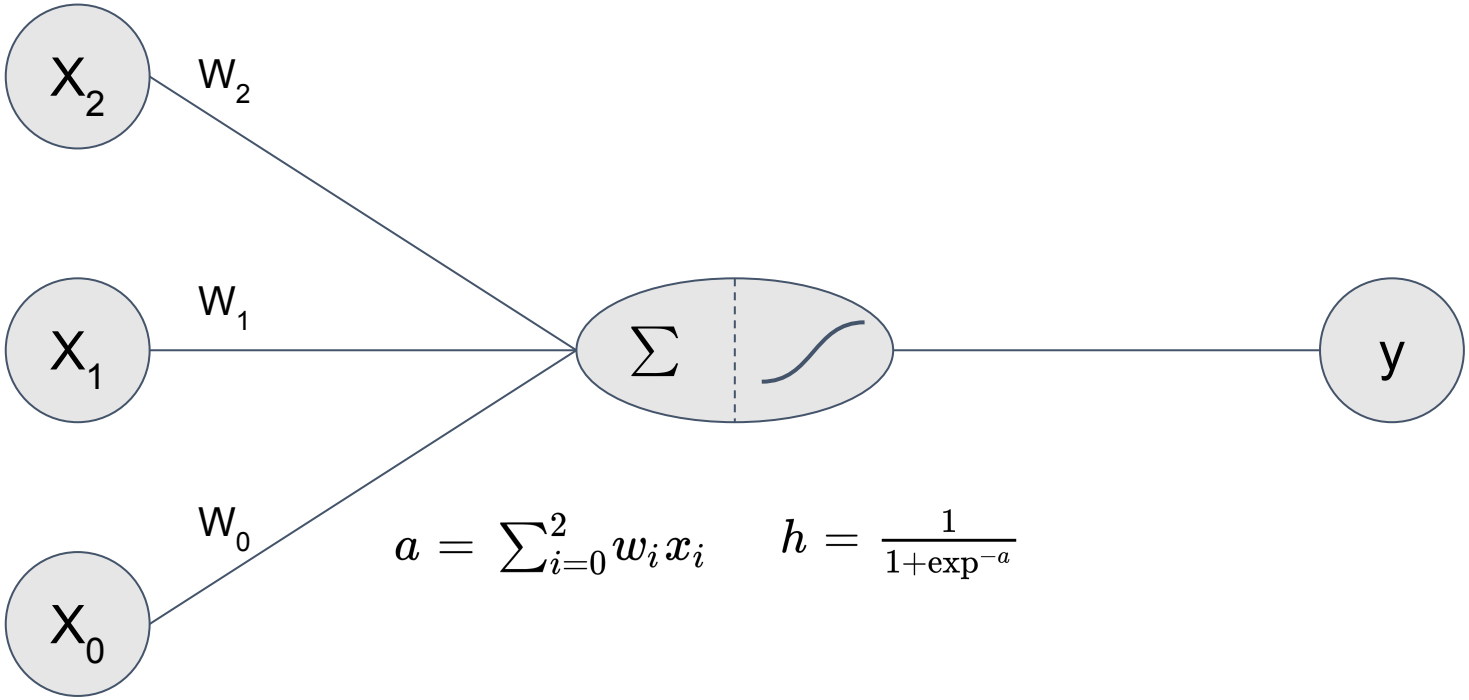
로지스틱 회귀

Y 범주형 : 입력변수(X)의 비선형결합으로 출력변수(Y)를 표현

$$f(X) = \frac{1}{1+e^{-(w_0+w_1X_1+w_2X_2+...+w_nX_n)}}$$



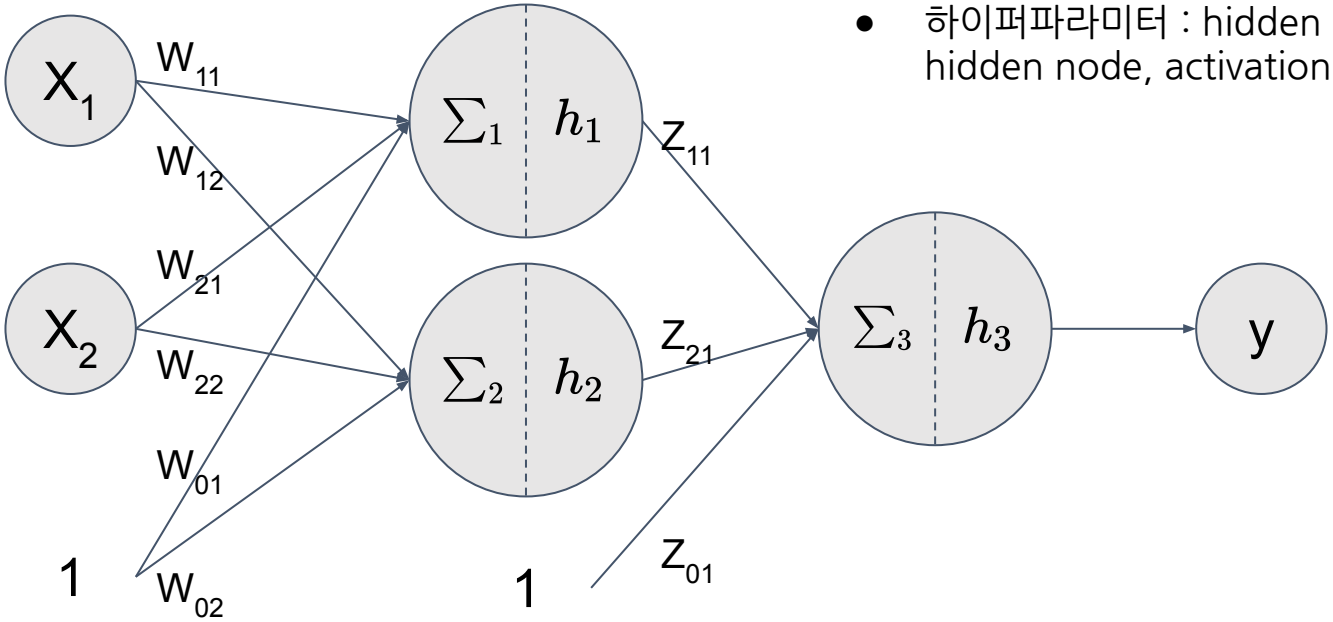
로지스틱 회귀



$$a = \sum_{i=0}^{2} w_i x_i \qquad h = \frac{1}{1+\exp^{-a}}$$

인공 신경망 파라미터

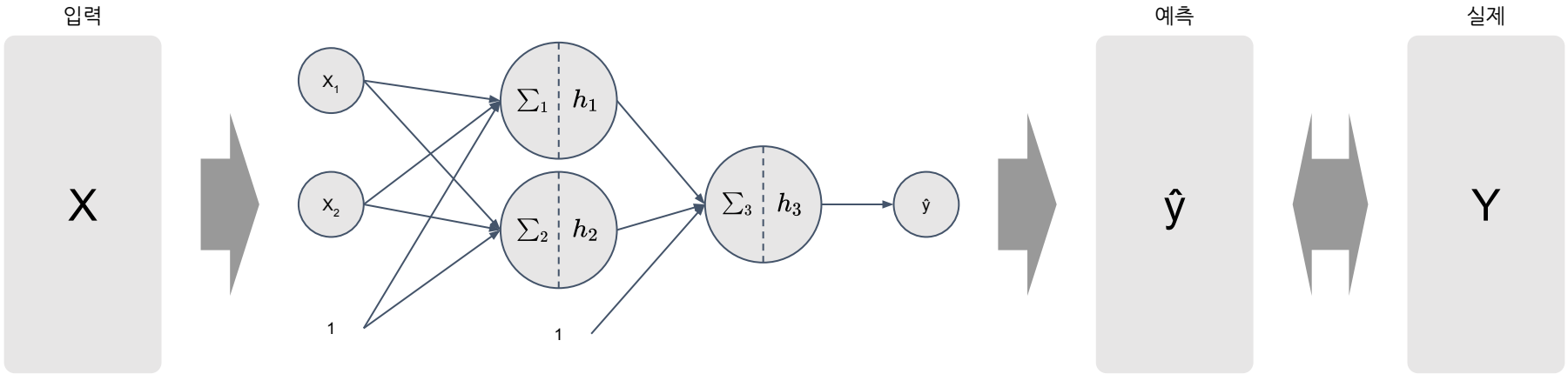
- 파라미터 : 가중치 (w, z)
- 하이퍼파라미터 : hidden layer, hidden node, activation function



비용함수 (Cost Function)

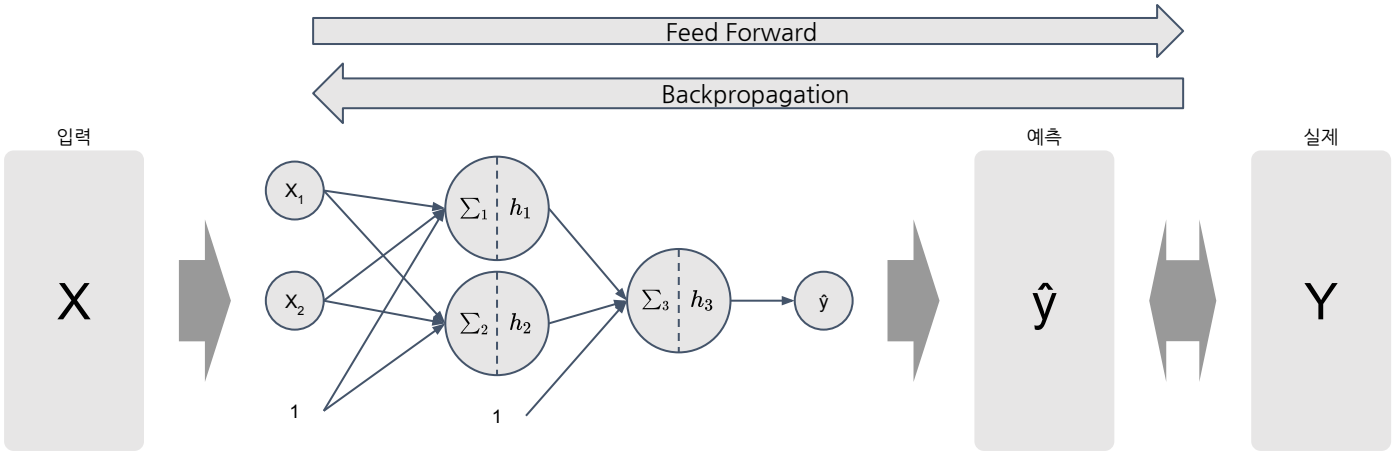
- 예측값 Y와 실제값 Y의 차이를 최소로 하는 함수

$$\text{argmin} \sum_i L(Y, f(X; w))$$



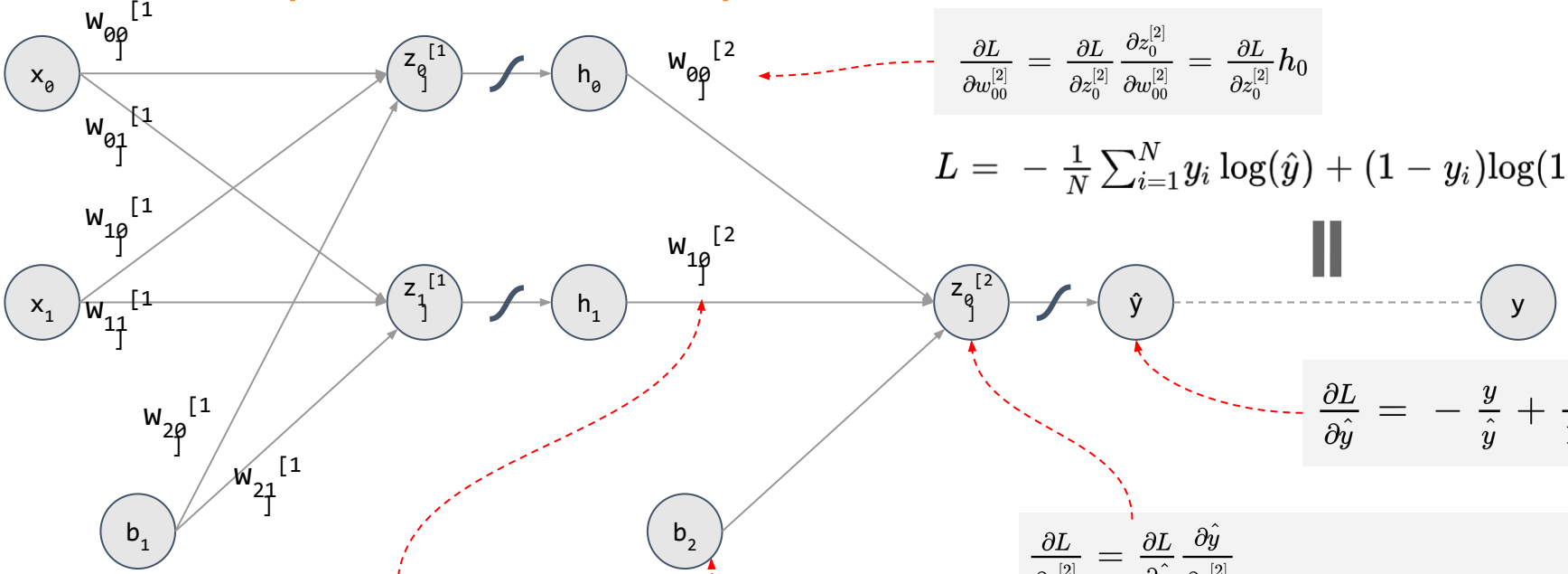
역전파 (Backpropagation)

- 오차 역전파법(Backpropagation) 또는 오류 역전파 알고리즘은 다층 퍼셉트론 학습에 사용되는 통계적 기법
- 경사 하강법 (Gradient Descent) : 손실함수의 기울기(=가중치의 편미분)에 학습률(learning rate)을 반영하여 가중치(파라미터)를 갱신하여 학습



Insight campus SeSAC

경사하강법 (Gradient Descent) - Gradient



$$\frac{\partial L}{\partial w_{00}^{[2]}} = \frac{\partial L}{\partial z_0^{[2]}} \frac{\partial z_0^{[2]}}{\partial w_{00}^{[2]}} = \frac{\partial L}{\partial z_0^{[2]}} h_0$$

$$L = -\frac{1}{N}\sum_{i=1}^{N} y_i \log(\hat{y}) + (1-y_i)\log(1-\hat{y})$$

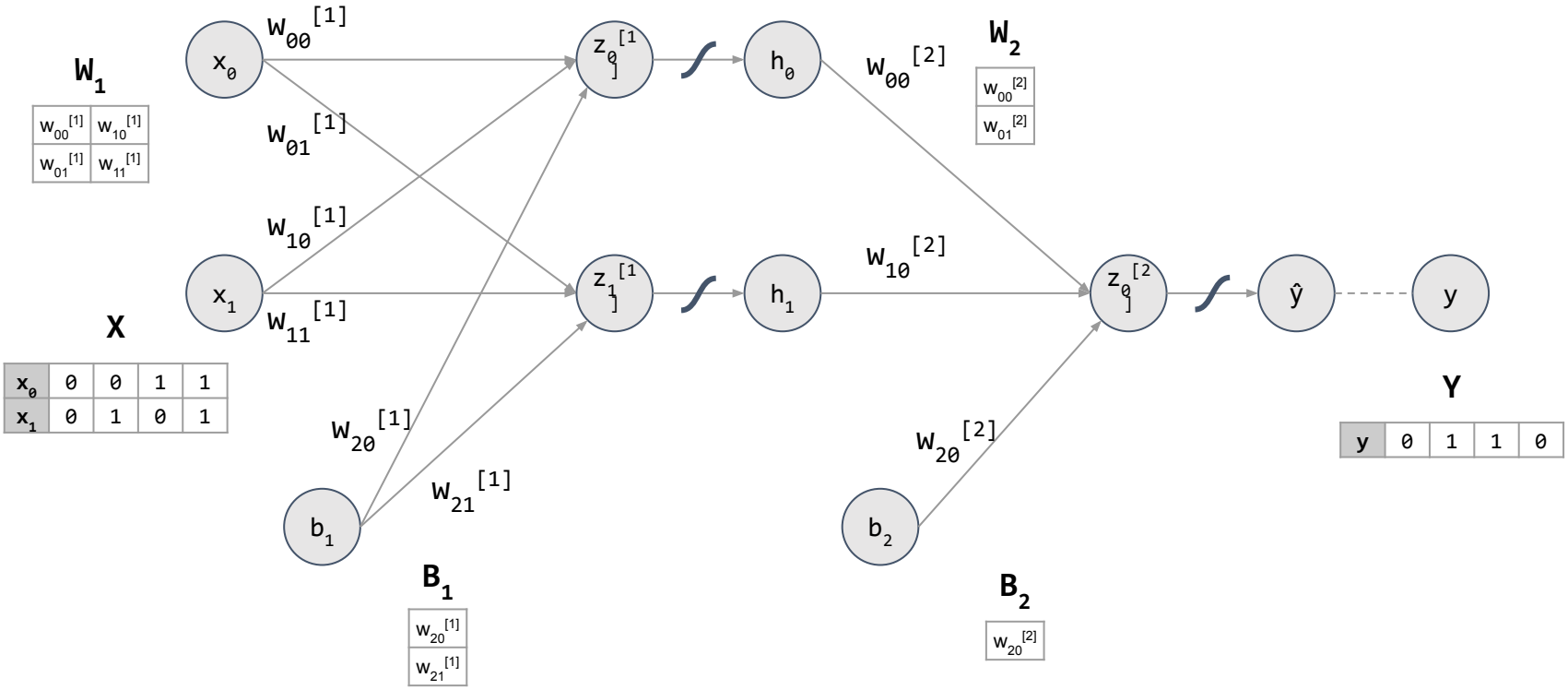
$$\frac{\partial L}{\partial \hat{y}} = -\frac{y}{\hat{y}} + \frac{1-y}{1-\hat{y}}$$

$$\frac{\partial L}{\partial w_{10}^{[2]}} = \frac{\partial L}{\partial z_0^{[2]}} \frac{\partial z_0^{[2]}}{\partial w_{10}^{[2]}} = \frac{\partial L}{\partial z_0^{[2]}} h_1$$

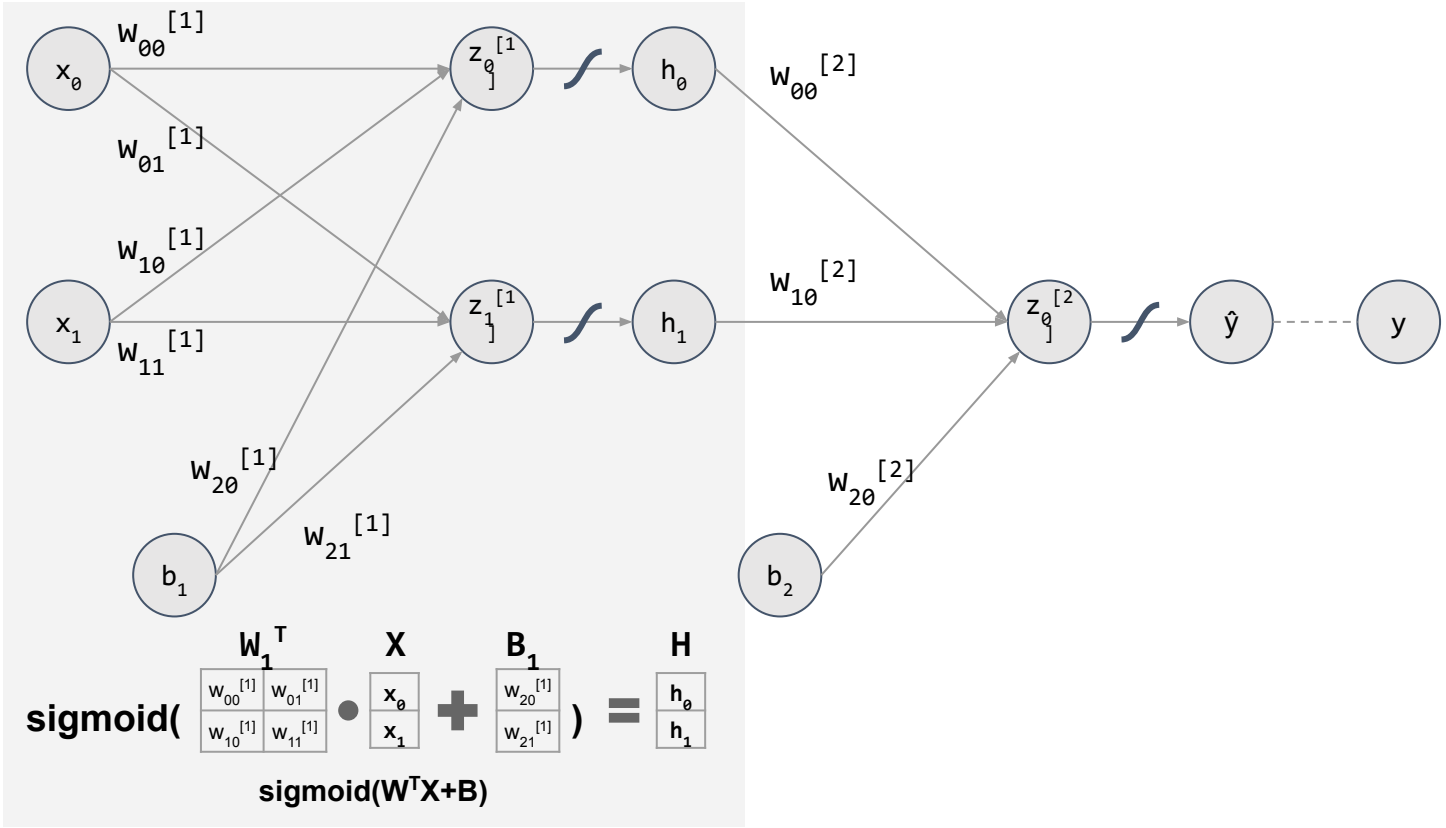
$$\frac{\partial L}{\partial b_2} = \frac{\partial L}{\partial z_0^{[2]}}$$

$$\frac{\partial L}{\partial z_0^{[2]}} = \frac{\partial L}{\partial \hat{y}} \frac{\partial \hat{y}}{\partial z_0^{[2]}} = \left(-\frac{y}{\hat{y}} + \frac{1-y}{1-\hat{y}}\right)\hat{y}(1-\hat{y}) = \hat{y} - y$$

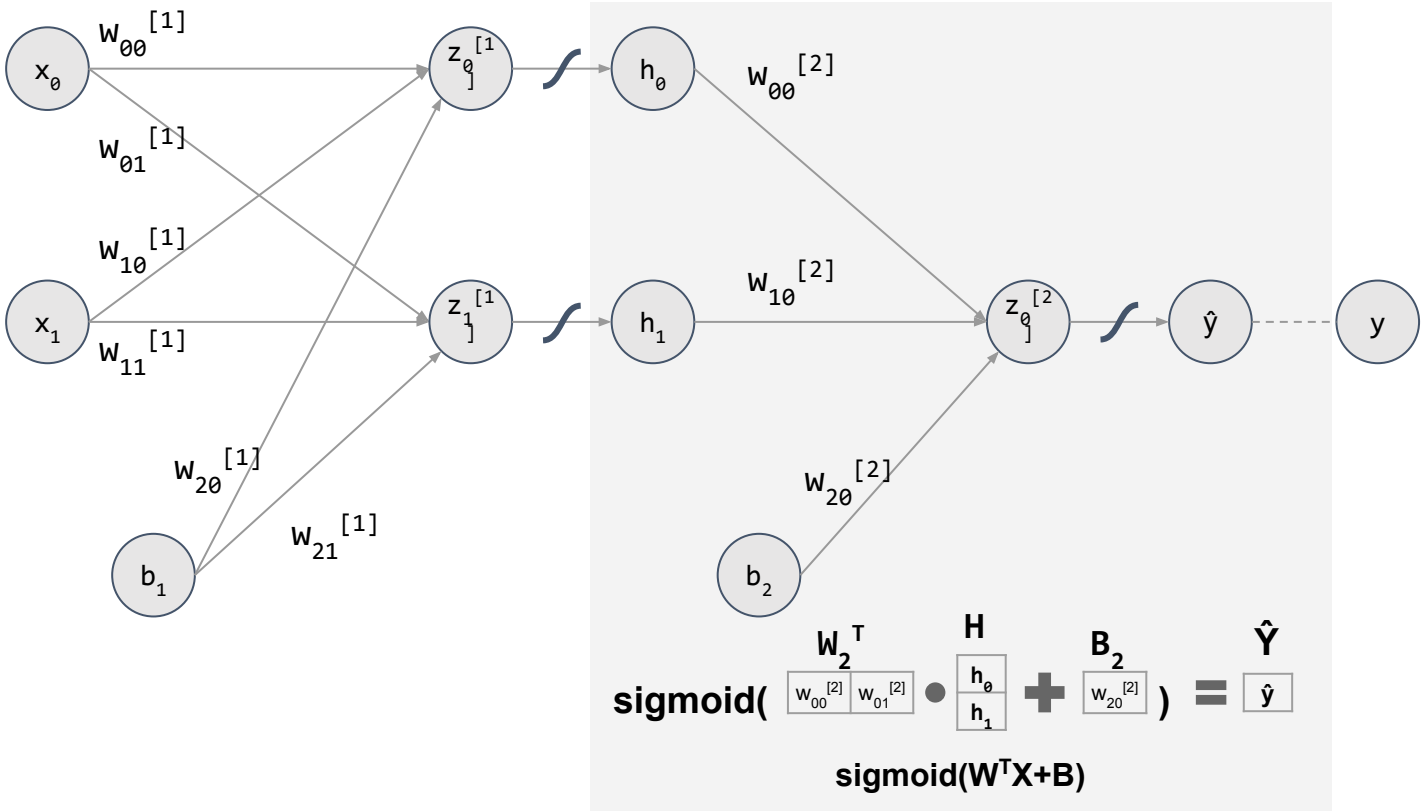
예제 : XOR


W1
W00 [1]
W10 [1]
W01 [1]
W11 [1]
x0
x1
z0 [1]
z1 [1]
h0
h1
W2
W00 [2]
W10 [2]
W01 [2]
z0 [2]
ŷ
y
X
x0 0 0 1 1
x1 0 1 0 1
W20 [1]
W21 [1]
b1
B1
w20 [1]
w21 [1]
W20 [2]
b2
B2
w20 [2]
Y
y 0 1 1 0

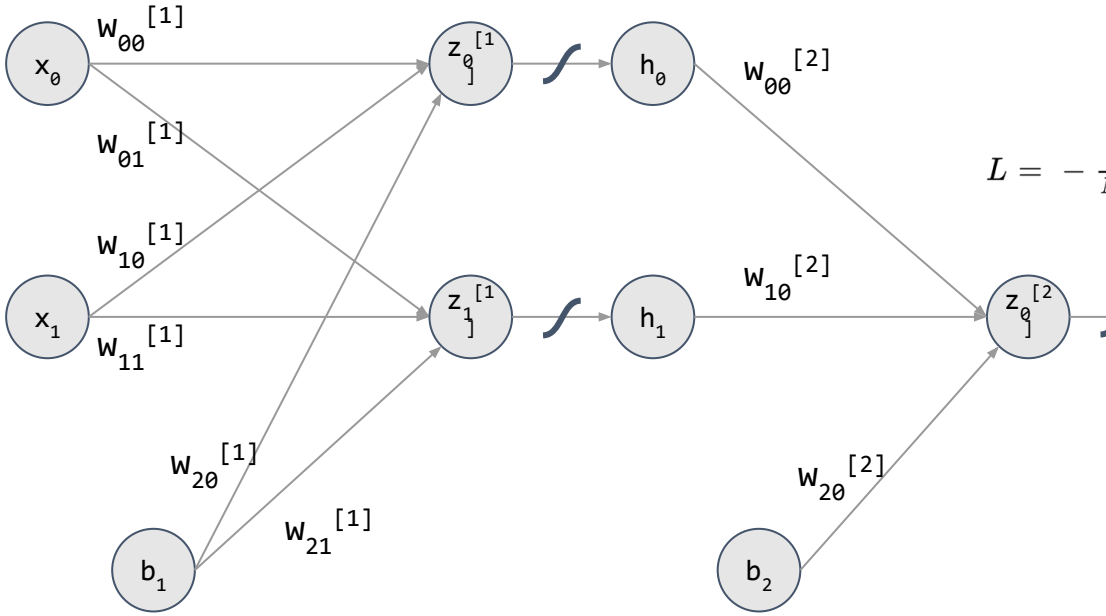
예제 : XOR - Feed forward(1)



예제 : XOR - Feed forward(2)



예제 : XOR - Loss/Gradient 계산



$$L = -\frac{1}{N}\sum_{i=1}^{N} y_i \log(\hat{y}) + (1-y_i)\log(1-\hat{y})$$

$$\frac{\partial L}{\partial W_2} = H\left(\hat{Y} - Y\right)^T$$

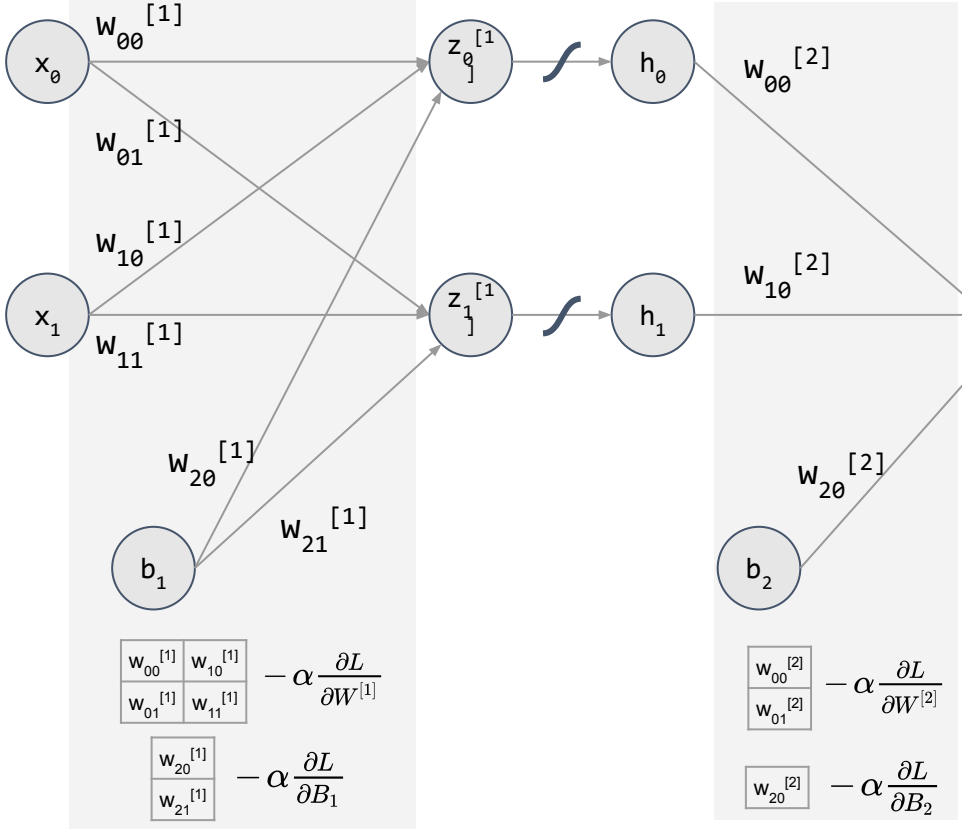
$$\frac{\partial L}{\partial B_2} = \left(\hat{Y} - Y\right)$$

$$\frac{\partial L}{\partial H} = W_2\left(\hat{Y} - Y\right)$$

$$\frac{\partial L}{\partial W_1} = x\left(\frac{\partial L}{\partial H} \odot H \odot \left(\begin{bmatrix}1\\1\end{bmatrix} - H\right)\right)^T$$

$$\frac{\partial L}{\partial B_1} = \frac{\partial L}{\partial H} \odot H \odot \left(\begin{bmatrix}1\\1\end{bmatrix} - H\right)$$

예제 : XOR - Weight(Parameter) 갱신



$$L = -\frac{1}{N}\sum_{i=1}^{N} y_i \log(\hat{y}) + (1-y_i)\log(1-\hat{y})$$

$$\frac{\partial L}{\partial W_2} = H\left(\hat{Y} - Y\right)^T$$

$$\frac{\partial L}{\partial B_2} = \left(\hat{Y} - Y\right)$$

$$\frac{\partial L}{\partial H} = W_2\left(\hat{Y} - Y\right)$$

$$\frac{\partial L}{\partial W_1} = x\left(\frac{\partial L}{\partial H} \odot H \odot \left(\begin{bmatrix}1\\1\end{bmatrix} - H\right)\right)^T$$

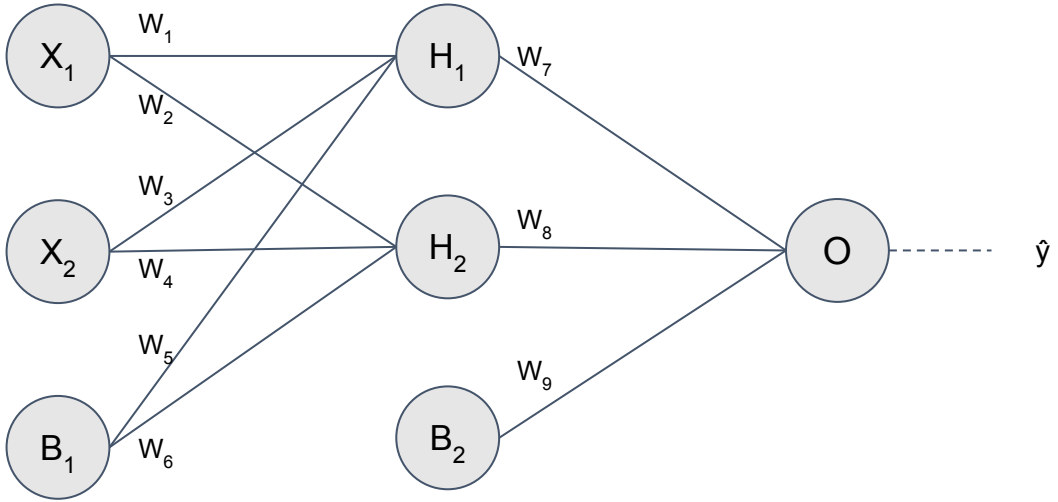
$$\frac{\partial L}{\partial B_1} = \frac{\partial L}{\partial H} \odot H \odot \left(\begin{bmatrix}1\\1\end{bmatrix} - H\right)$$

예제 : XOR

$$L = -\frac{1}{N}\sum_{i=1}^{N} y_i \log(\hat{y}) + (1-y_i)\log(1-\hat{y})$$

Hidden layer : 1개
Hidden node : 2개
activation func : sigmoid
loss : binary cross entropy

X1	X2	Y
0	0	0
0	1	1
1	0	1
1	1	0



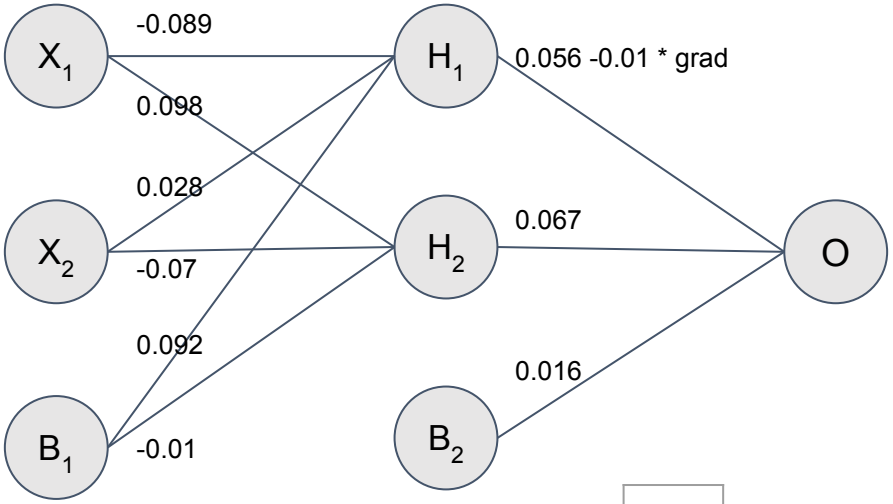
Insight campus SeSAC

예제 : XOR

X1	X2	Y	ŷ
0	0	0	0.52
0	1	1	0.5
1	0	1	0.52
1	1	0	055

X1	X2	B
0	0	1
0	1	1
1	0	1
1	1	1

epoch = 0



-0.089	0.028	0.092
0.098	-0.07	-0.01

0.056
0.067
0.016

0.52
0.5
0.52
055

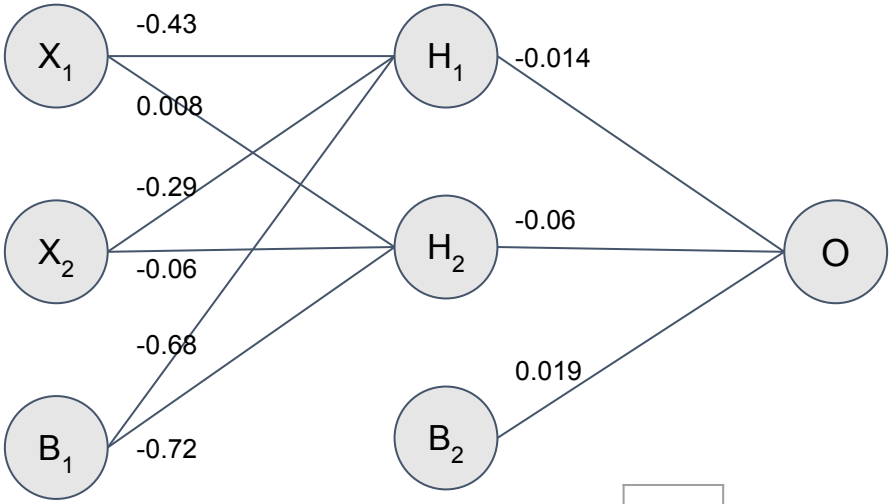
0
1
1
0

Insight campus SeSAC

예제 : XOR

epoch = 1000

X1	X2	Y	ŷ
0	0	0	0.50
0	1	1	0.48
1	0	1	0.50
1	1	0	052



-0.43	-0.29	-0.68
0.008	-0.06	-0.72

-0.014
-0.06
0.019

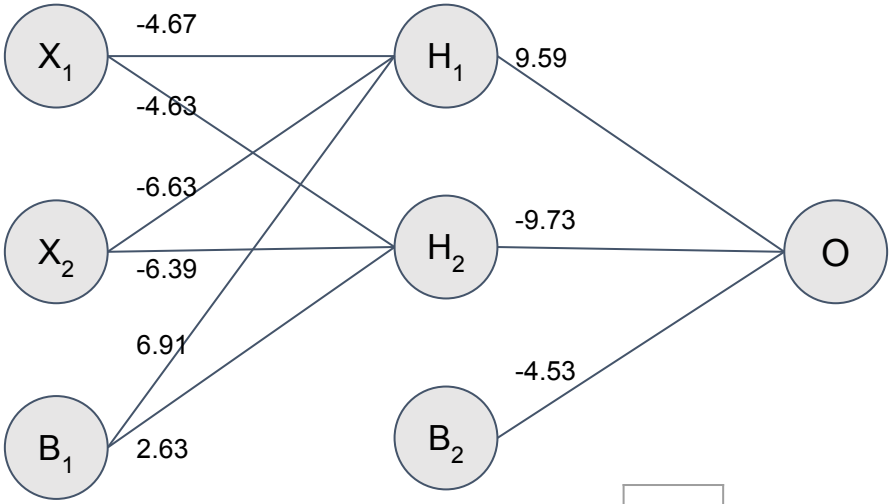
0.50
0.48
0.50
052

0
1
1
0

예제 : XOR

X1	X2	Y	ŷ
0	0	0	0.02
0	1	1	0.98
1	0	1	0.98
1	1	0	0.02

epoch = 10000



-4.67	-6.63	6.91
-4/63	-6.39	2.63

9.59
-9.73
-4.53

0.02
0.98
0.98
0.02

0
1
1
0

감사합니다.

Insight campus SeSAC

daniel@fins.ai