1번 문제

$$\frac{d}{dz}(1+e^{-z})^{-1} = -(1+e^{-z})^{-2}\frac{d}{dz}(1+e^{-z})$$

$$= -(1+e^{-z})^{-2}(0+e^{-z})\frac{d}{dz}(-z)$$

$$= (1+e^{-z})^{-2}\cdot e^{-z}$$

$$= \frac{e^{-z}}{(1+e^{-z})^2} = \frac{1+e^{-z}}{(1+e^{-z})^2} - \frac{1}{(1+e^{-z})^2}$$

$$= \frac{1}{1+e^{-z}} - \frac{1}{(1+e^{-z})^2}$$

$$= \frac{1}{1+e^{-z}}\left(1 - \frac{1}{1+e^{-z}}\right)$$

$$= g(z)(1-g(z))$$

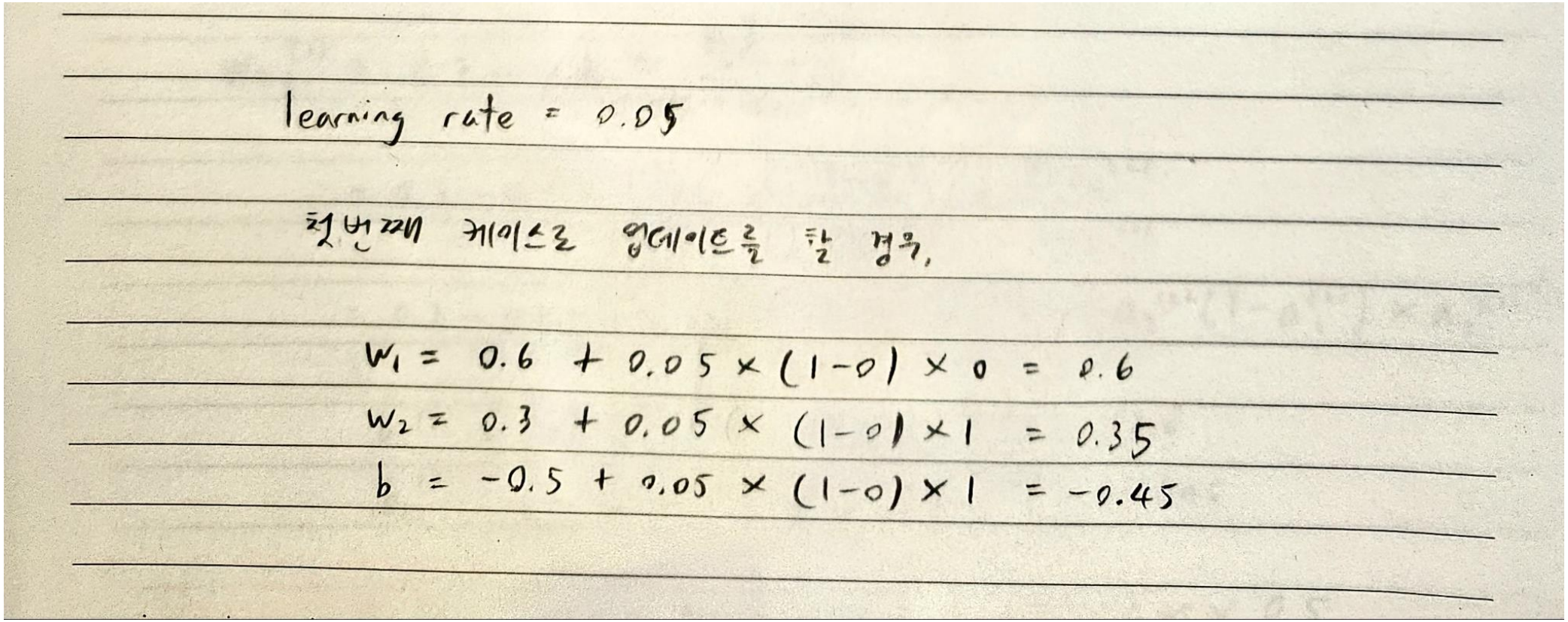
2-1번 문제

$w_1 = 0.6, w_2 = 0.3, b = 1$로 설정할 경우

x_1	x_2	b	y	
0	1	0	1	$0.6 \times 0 + 0.3 \times 1 - 0.5 = -0.2 \rightarrow 0$
0	0	0	1	$0.6 \times 0 + 0.3 \times 0 - 0.5 = -0.5 \rightarrow 0$
1	1	1	1	$0.6 \times 1 + 0.3 \times 1 - 0.5 = 0.4 \rightarrow 1$
1	0	1	0	$0.6 \times 1 + 0.3 \times 0 - 0.5 = 0.1 \rightarrow 1$

2-2번 문제

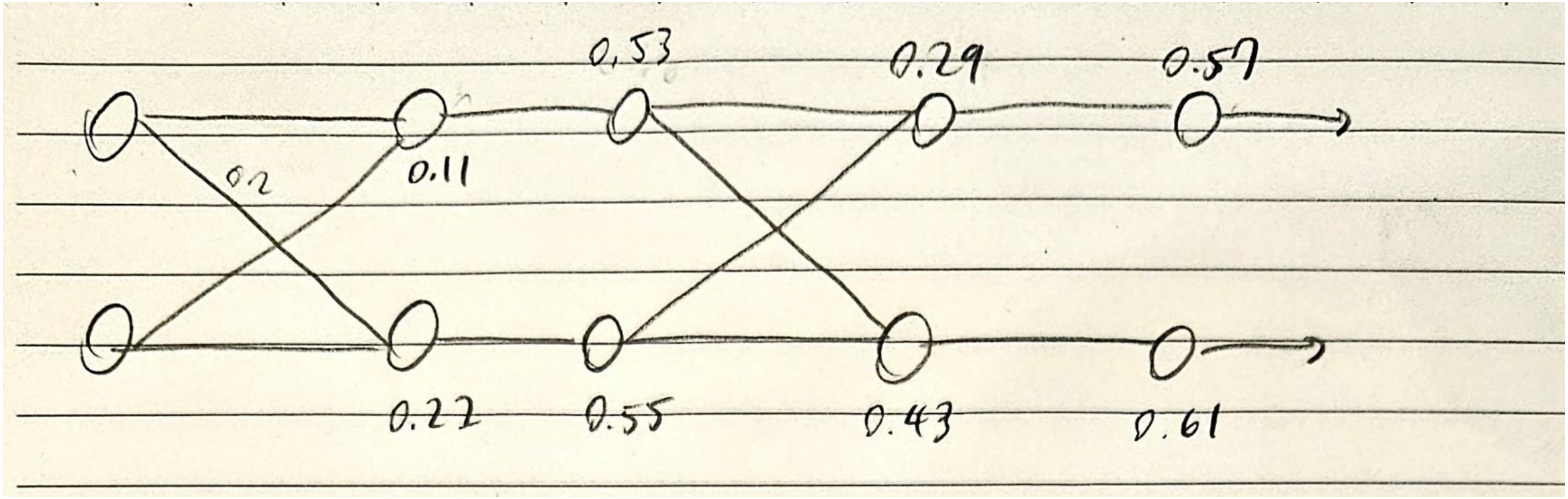
$learning\ rate = 0.05$로 설정할 경우



3-1번 문제

$z_1^{(2)} = 0.11$
$z_2^{(2)} = 0.22$
$a_1^{(2)} = 0.53$
$a_2^{(2)} = 0.55$

$z_1^{(3)} = 0.29$
$z_2^{(3)} = 0.43$
$a_1^{(3)} = 0.57$
$a_2^{(3)} = 0.61$



3-2번 문제

$$J_1 = \frac{1}{2}(0.51 - 0.5)^2 = 0.00245$$

$$J_2 = \frac{1}{2}(0.61 - 0.8)^2 = 0.01805$$

3-3번 문제

$$W_{2,2}^{(2)} = 0.45 - 0.1 \times \frac{\partial J}{\partial W_{2,2}^{(2)}} = 0.45 - 0.1 \times \frac{\partial J_2}{\partial a_2^{(3)}} \times \frac{\partial a_2^{(3)}}{\partial z_2^{(3)}} \times \frac{\partial z_2^{(3)}}{\partial W_{2,2}^{(2)}}$$

$$= 0.45 - 0.1 \times (0.61 - 0.8) \times 0.61 \times (1 - 0.61) \times 0.55$$

$$= 0.452486055$$

$$W_{2,1}^{(1)} = 0.2 - 0.1 \times \frac{\partial J}{\partial W_{2,1}^{(1)}}$$

$$= 0.2 - 0.1 \times \frac{\partial J_2}{\partial a_2^{(2)}} \times \frac{\partial a_2^{(2)}}{\partial z_2^{(2)}} \times \frac{\partial z_2^{(2)}}{\partial W_{2,1}^{(1)}}$$

$$= 0.2 - 0.1 \times (b_1^{(3)} W_{1,2}^{(2)} + b_2^{(3)} W_{2,2}^{(2)}) \times a_2^{(2)}(1 - a_2^{(2)}) \times a_1^{(1)}$$

$$b_1^{(3)} = (a_1^{(3)} - y_1) \times a_1^{(3)}(1 - a_1^{(3)}) = 0.019$$

$$b_2^{(3)} = (a_2^{(3)} - y_2) \times a_2^{(3)}(1 - a_2^{(3)}) = -0.045$$

$$\Rightarrow W_{2,1}^{(1)} = 0.2 - 0.1 \times (-0.018) \times 0.55 \times 0.45 \times 0.5$$

$$= 0.20022295$$

morning glory