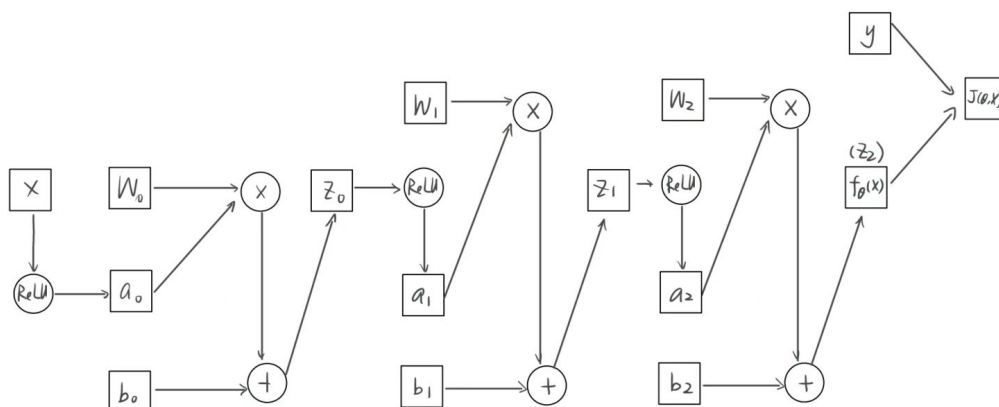# Pattern Recognition and Machine Learning: Homework 2

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Problem 1

The computing graph of the loss is as below.

Problem 2

For the 2th layer:

$$\frac{\partial J}{\partial y} = -(z_2 - y)$$

$$\frac{\partial J}{\partial z_2} = z_2 - y$$

$$\frac{\partial J}{\partial a_2} = \frac{\partial z_2}{\partial a_2}\frac{\partial J}{\partial z_2} = W_2\frac{\partial J}{\partial z_2}$$

$$\frac{\partial J}{\partial W_2} = \frac{\partial z_2}{\partial W_2}\frac{\partial J}{\partial z_2} = a_2\frac{\partial J}{\partial z_2}$$

$$\frac{\partial J}{\partial b_2} = \frac{\partial z_2}{\partial b_2}\frac{\partial J}{\partial z_2} = \frac{\partial J}{\partial z_2}$$

For the 1th layer:

$$\frac{\partial J}{\partial z_1} = \frac{\partial a_2}{\partial z_1}\frac{\partial J}{\partial a_2} = g'(z_1)\frac{\partial J}{\partial a_2} = H(z_1)\frac{\partial J}{\partial a_2}$$

$$\frac{\partial J}{\partial a_1} = \frac{\partial z_1}{\partial a_1}\frac{\partial J}{\partial z_1} = W_1\frac{\partial J}{\partial z_1}$$

$$\frac{\partial J}{\partial W_1} = \frac{\partial z_1}{\partial W_1}\frac{\partial J}{\partial z_1} = a_1\frac{\partial J}{\partial z_1}$$

$$\frac{\partial J}{\partial b_1} = \frac{\partial z_1}{\partial b_1}\frac{\partial J}{\partial z_1} = \frac{\partial J}{\partial z_1}$$

For the 0th layer:

$$\frac{\partial J}{\partial z_0} = \frac{\partial a_1}{\partial z_0}\frac{\partial J}{\partial a_1} = g'(z_0)\frac{\partial J}{\partial a_1} = H(z_0)\frac{\partial J}{\partial a_1}$$

$$\frac{\partial J}{\partial a_0} = \frac{\partial z_0}{\partial a_0}\frac{\partial J}{\partial z_0} = W_0\frac{\partial J}{\partial z_0}$$

$$\frac{\partial J}{\partial W_0} = \frac{\partial z_0}{\partial W_0}\frac{\partial J}{\partial z_0} = a_0\frac{\partial J}{\partial z_0}$$

$$\frac{\partial J}{\partial b_0} = \frac{\partial z_0}{\partial b_0}\frac{\partial J}{\partial z_0} = \frac{\partial J}{\partial z_0}$$

$$\frac{\partial J}{\partial x} = \frac{\partial a_0}{\partial x}\frac{\partial J}{\partial a_0} = g'(x)\frac{\partial J}{\partial a_0} = H(x)\frac{\partial J}{\partial a_0}$$