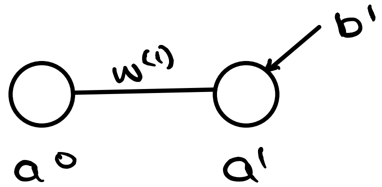
PROBLEM #1

Imagine you were trying to build a simple neural net to learn how to not the input value.

The net. looked like this,



Given the activation function,

$$\sigma(z) = \tanh(z)$$
$$w = 1.3$$
$$b = -0.1$$

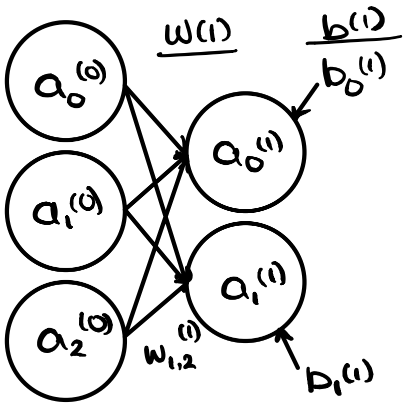
And the output of a^1,

$$\sigma(w * a^0 + b)$$

Which of these weights and biases would best produce $!a^0$?

- [ ] $w^{(1)} = 10,\ b^{(1)} = 0$
- [ ] $w^{(1)} = 3,\ b^{(1)} = 1$
- [ ] $w^{(1)} = -3,\ b^{(1)} = 0$
- [ ] $w^{(1)} = 0,\ b^{(1)} = 5$
- [x] $w^{(1)} = -5,\ b^{(1)} = 5$

Problem #2.



$$a^{(1)} = \sigma(W^{(1)} a^{(0)} + b^{(1)})$$

Notes:

- superscript is layer
- subscript is index in that layer forming a vector.
- weights form matrix W, each element w_{ij} is the link between j in the previous layer and neuron i in the current layer.
  - ex. $w_{1,2}$ links $a_2^{(0)}$ to $a_1^{(1)}$.
- biases also form a vector, $b^{(1)}$.

All quantities of interest have been upgraded to their vector and matrix form and σ acts upon each element of the resulting weighted sum vector seperately

For a network with weights,

$$W^{(1)} = \begin{bmatrix} -2 & 4 & 1 \\ 6 & 0 & -3 \end{bmatrix}$$

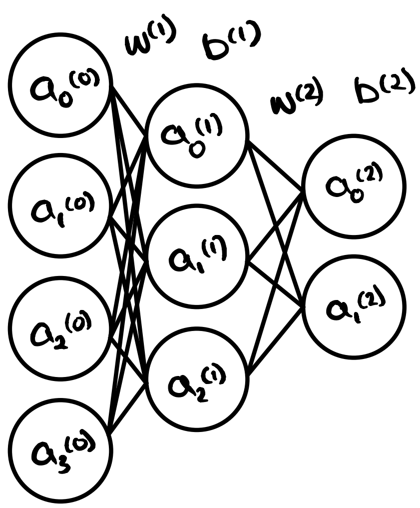
$$b = \begin{bmatrix} 0.1 \\ -2.5 \end{bmatrix}$$

$$a^{(0)} = \begin{bmatrix} 0.3 \\ 0.4 \\ 0.1 \end{bmatrix}$$

Calculate the output, $a^{(1)}$, given an input vector $a^{(0)}$.

$$a^{(1)} = \sigma\left(\begin{bmatrix} -2 & 4 & 1 \\ 6 & 0 & -3 \end{bmatrix}\begin{bmatrix} 0.3 \\ 0.4 \\ 0.1 \end{bmatrix} + \begin{bmatrix} 0.1 \\ -2.5 \end{bmatrix}\right)$$

PROBLEM #3



(*) Biases are implicit.

This is a network with a hidden layer.

Data is ingested at layer (0), this activates neurons in layer (1), and those outputs become inputs for neurons in layer (2).

Which of the following statements are true,

- [ ] the number of weights in a layer is the sum of the input and output neurons to that layer plus 1.
- [ ] none of the other statements are true.
- [ ] neural net has 9 biases
- [x] neural net has 5 biases
- [ ] net can be replaced with another of the same number of input and output neurons, but no hidden
- [x] the number of weights in a layer is the product of the input & output to that layer

PROBLEM #4.

Which of the following statements about the previous problem are true?

- [ ] $a^{(2)} = \sigma(W^{(2)}W^{(1)}a^{(0)} + W^{(2)}b^{(1)} + b^{(2)})$
- [ ] $a^{(2)} = \sigma(W^{(1)}a^{(1)} + b^{(2)})$
- [x] $a^{(2)} = \sigma(W^{(2)}\sigma(W^{(1)}a^{(0)} + b^{(1)}) + b^{(2)})$
- [ ] none of the other statements