Problem 1

An MLP has two input nodes, one hidden layer, and two outputs. The two sets of weights and biases are given by:

$$W_1 = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix} \quad b_1 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 2 & 2 \\ 2 & -3 \end{bmatrix} \quad b_2 = \begin{bmatrix} 0 \\ -4 \end{bmatrix}$$

The non-linear activation for the hidden layer is ReLU (rectified linear unit) – that is $h(x) = \max(x, 0)$. The output layer is linear (i.e., identity activation function). The output for layer l is given by $a^{(l)} = h_l(W_l a^{(l-1)} + b_l)$.

What is the output activation for input $x = [+1; -1]^T$?

1(x1)+(-2)(x2)+1 = z1

1+(2)+1 = z1= 4 hidden neuron 1

3(x1)+(4)(x2)+0 = 3+(-4)+0 = -1

z2=-1 hidden neuron 2

hidden output before activation = (4,-1)

h1 = RELU(X1) = 4

h2 = RELU(X2) = 0

hidden layer is (4,0)

output 1 y1 = 2(x1)+2(x2)+0

y1= 2(4)+2(0)+0 = 8

Y2 = 2(x1)+(-3)(x2)+(-4)

Y2 = 2(4)+(-3)(0)+(-4) = 4

Output a1 = (8,4)