Single-Layer Neural Network Worksheet **DATA 5322 Statistical Machine Learning II**

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Adapted from exercise 10.10.1 ISLR

Using a neural network, the goal is to predict if I will buy a car based on the price alone. 7 example observations are given in the table below. The input X gives car price in thousands of dollars and the response Y gives my purchase decision.

Consider a fully-connected single-layer neural network with 1 node in the input layer, 3 nodes in the hidden layer, and 1 node in the output layer. The weights and biases for each connection are given at the right.

Obs	X	Y	$f(X)$
1	0	yes	0.5[9109]
2	5	no	0.34858
3	19	no	
4	20	yes	0.45
5	45	yes	0.50
6	50	no	0.54
7	60	no	0.00025

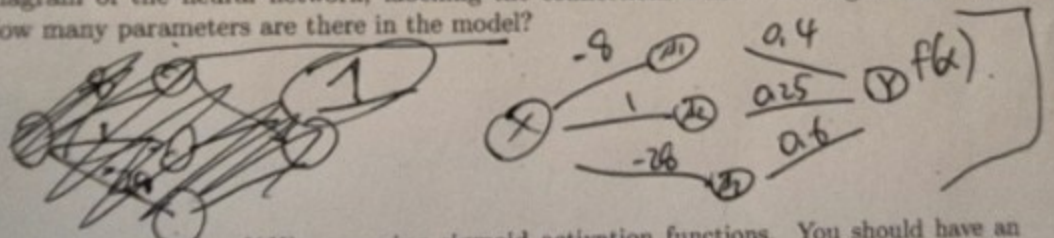
$\beta_0 = 1.25$

$\beta_1 = 0.5$ $\quad \omega_{1,0} = -8$ $\quad \omega_{1,1} = 0.4$

$\beta_2 = -1$ $\quad \omega_{2,0} = 1$ $\quad \omega_{2,1} = 0.25$

$\beta_3 = -0.75$ $\quad \omega_{3,0} = -28$ $\quad \omega_{3,1} = 0.6$

(a) Draw a diagram of the neural network, labelling the connections where the weights and biases belong. How many parameters are there in the model?



(b) Write out an expression for $f(X)$, assuming sigmoid activation functions. You should have an equation that includes all weights and biases and maps from input (X) to output (Y).

$f(x) = 1.25 + 0.5(g(-8x+0.4)) - 1(g(1+0.25x)) - 0.75(g(-28x+0.6))$

A_1 A_2 A_3

shown, find the value for