CS491 Quiz 7 Name Solution

1. You want to train the following model using gradient descent. Here, the input $x$ and target $y$ are both scalar-valued. Use the chain rule to give the expression for the back propagation rule to update $w_2$. Make sure to give each portion of the chain rule explicitly, as well as the final update rule. (8 points)

$$z = w_0 + w_1 x + w_2 x^2$$

$$y = 1 + e^z$$

$$L = \frac{1}{2}(\hat{y} - y)^2$$

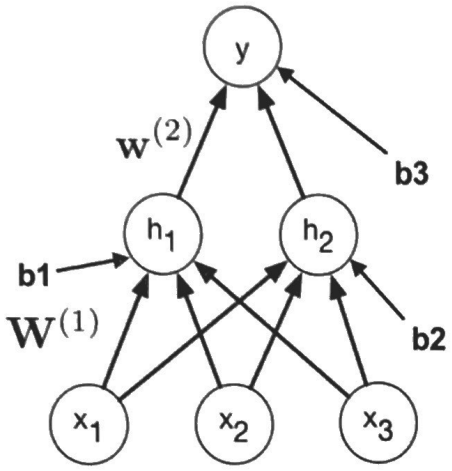
$$\frac{\partial L}{\partial y} = -(\hat{y} - y) \qquad \frac{\partial y}{\partial z} = e^z \qquad \frac{\partial z}{\partial w_2} = x^2$$

$$w_2 = w_2 - \eta \frac{\partial L}{\partial y} \frac{\partial y}{\partial z} \frac{\partial z}{\partial w_2}$$

2. Consider the binary threshold neuron, $h = sign(w \bullet x)$ defined such that $h \in \{0,1\}$, with no bias $b$. Consider the following set of four input features, $x$: $(1,0,0)$, $(0,1,0)$, $(0,0,1)$, $(1,1,1)$. Find a three-dimensional parameter vector $w$ such that the neuron will have the output pattern $h = \{1,1,1,1\}$ for the given four input features. (2 points)

$$w = (1, 1, 1)$$

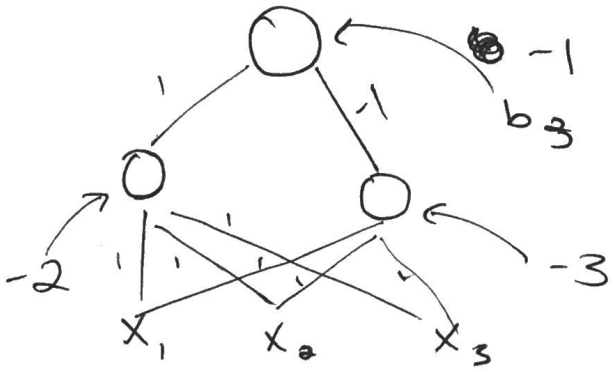
CS691 Quiz 7 Name Solution




1. Your job is to design a multilayer perceptron which receives three binary-valued (i.e. 0 or 1) inputs x1,x2,x3, and outputs 1 if exactly two of the inputs are 1, and outputs 0 otherwise. All of the units use a hard threshold activation function: $z = 1$ if $z \geq 0$ and $z = 0$ otherwise.

   Specify weights and biases which correctly implement this function. There is a bias for each hidden unit as well as the output unit. You do not need to explain your solution. (9 points)

| | | | |
|---|---|---|---|
| X | 0 | 0 | 0 |
| X | 0 | 0 | 1 |
| X | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 |
| X | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |
| X | 1 | 1 | 1 |




Many Solutions to this.

2. Consider the binary threshold neuron, $h = sign(w \bullet x)$ defined such that $h \in \{0, 1\}$, with no bias $b$. Consider the following set of four input features, $x$: $(1, 0, 0)$, $(0, 1, 0)$, $(0, 0, 1)$, $(1, 1, 1)$. Find a three-dimensional parameter vector $w$ such that the neuron will have the output pattern $h = \{1, 1, 1, 1\}$ for the given four input features. (1 point)

$w = (1, 1, 1)$