



# Neural Networks: Representation

5 questions

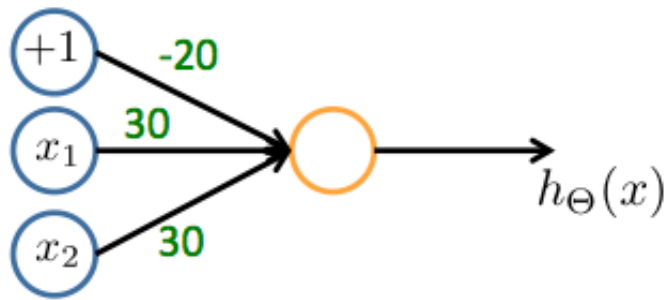
1.

Which of the following statements are true? Check all that apply.

- ☐ A two layer (one input layer, one output layer; no hidden layer) neural network can represent the XOR function.
- ☐ Suppose you have a multi-class classification problem with three classes, trained with a 3 layer network. Let  $a_1^{(3)} = (h_{\Theta}(x))_1$  be the activation of the first output unit, and similarly  $a_2^{(3)} = (h_{\Theta}(x))_2$  and  $a_3^{(3)} = (h_{\Theta}(x))_3$ . Then for any input  $x$ , it must be the case that  $a_1^{(3)} + a_2^{(3)} + a_3^{(3)} = 1$ .
- ☐ Any logical function over binary-valued (0 or 1) inputs  $x_1$  and  $x_2$  can be (approximately) represented using some neural network.
- ☐ The activation values of the hidden units in a neural network, with the sigmoid activation function applied at every layer, are always in the range (0, 1).

2.

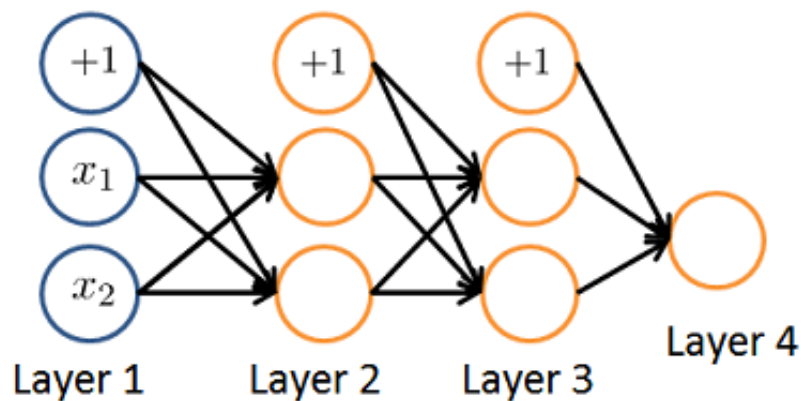
Consider the following neural network which takes two binary-valued inputs  $x_1, x_2 \in \{0, 1\}$  and outputs  $h_{\Theta}(x)$ . Which of the following logical functions does it (approximately) compute?



- ☐ OR
- ☐ AND
- ☐ NAND (meaning "NOT AND")
- ☐ XOR (exclusive OR)

3.

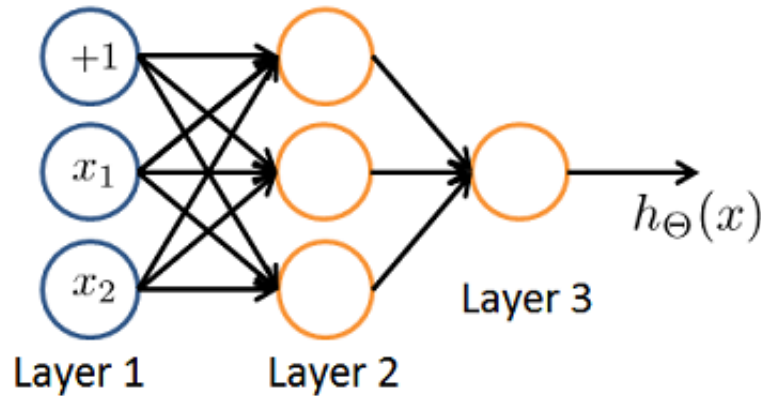
Consider the neural network given below. Which of the following equations correctly computes the activation  $a_1^{(3)}$ ? Note:  $g(z)$  is the sigmoid activation function.



- ☐  $a_1^{(3)} = g(\Theta_{1,0}^{(2)} a_0^{(2)} + \Theta_{1,1}^{(2)} a_1^{(2)} + \Theta_{1,2}^{(2)} a_2^{(2)})$
- ☐  $a_1^{(3)} = g(\Theta_{1,0}^{(1)} a_0^{(1)} + \Theta_{1,1}^{(1)} a_1^{(1)} + \Theta_{1,2}^{(1)} a_2^{(1)})$
- ☐  $a_1^{(3)} = g(\Theta_{1,0}^{(1)} a_0^{(2)} + \Theta_{1,1}^{(1)} a_1^{(2)} + \Theta_{1,2}^{(1)} a_2^{(2)})$
- ☐ The activation  $a_1^{(3)}$  is not present in this network.

4.

You have the following neural network:



You'd like to compute the activations of the hidden layer  $a^{(2)} \in \mathbb{R}^3$ . One way to do so is the following Octave code:

```
% Theta1 is Theta with superscript "(1)" from lecture
% ie, the matrix of parameters for the mapping from layer 1 (input) to layer 2
% Theta1 has size 3x3
% Assume 'sigmoid' is a built-in function to compute 1 / (1 + exp(-z))

a2 = zeros (3, 1);
for i = 1:3
    for j = 1:3
        a2(i) = a2(i) + x(j) * Theta1(i, j);
    end
    a2(i) = sigmoid (a2(i));
end
```

You want to have a vectorized implementation of this (i.e., one that does not use for loops). Which of the following implementations correctly compute  $a^{(2)}$ ? Check all that apply.

☐  $z = \text{Theta1} * x$ ;  $a2 = \text{sigmoid} (z)$ ;

☐  $a2 = \text{sigmoid} (x * \text{Theta1})$ ;

☐  $a2 = \text{sigmoid} (\text{Theta2} * x)$ ;


 $z = \text{sigmoid}(x); a2 = \text{sigmoid}(\text{Theta1} * z);$ 

5.

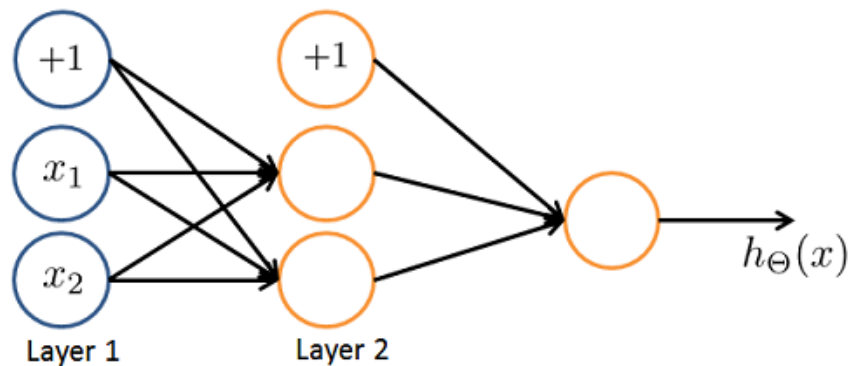
You are using the neural network pictured below and have learned

the parameters  $\Theta^{(1)} = \begin{bmatrix} 1 & 0.5 & 1.9 \\ 1 & 1.2 & 2.7 \end{bmatrix}$  (used to compute  $a^{(2)}$ )

and  $\Theta^{(2)} = \begin{bmatrix} 1 & -0.2 & -1.7 \end{bmatrix}$  (used to compute  $a^{(3)}$ ) as a function of  $a^{(2)}$ . Suppose you swap the parameters for the first

hidden layer between its two units so  $\Theta^{(1)} = \begin{bmatrix} 1 & 1.2 & 2.7 \\ 1 & 0.5 & 1.9 \end{bmatrix}$  and

also swap the output layer so  $\Theta^{(2)} = \begin{bmatrix} 1 & -1.7 & -0.2 \end{bmatrix}$ . How will this change the value of the output  $h_{\Theta}(x)$ ?



- ☐ It will stay the same.
- ☐ It will increase.
- ☐ It will decrease
- ☐ Insufficient information to tell: it may increase or decrease.

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