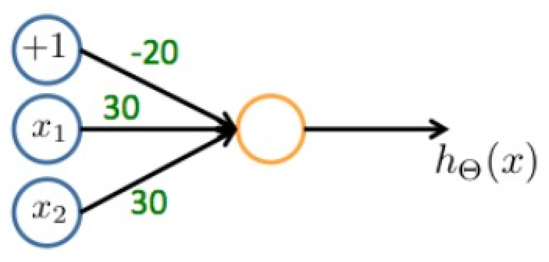
1 point

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.
- [x] Any logical function over binary-valued (0 or 1) inputs $x_1$ and $x_2$ can be (approximately) represented using some neural network.
- [ ] 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 $a_1^{(3)} + a_2^{(3)} + a_3^{(3)} = 1$.
- [ ] 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).

1 point

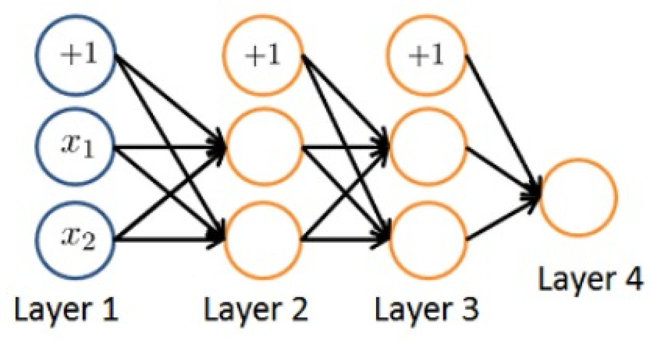
2. Consider the following neural network which takes two binary-valued inputs $x_1, x_2 \in \{0, 1\}$ and outputs $h_\Theta(x)$. Which of the following logical functions does it (approximately) compute?




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

1 point

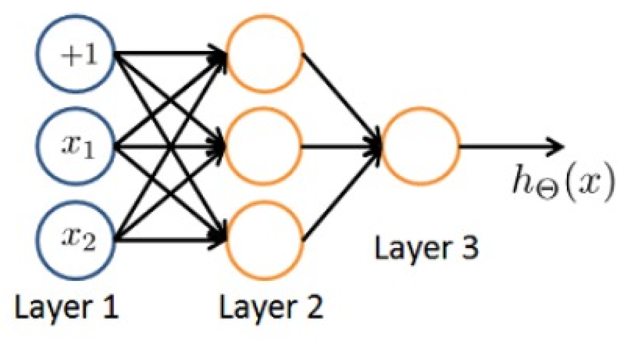
3. Consider the neural network given below. Which of the following equations correctly computes the activation $a_1^{(3)}$? Note: $g(z)$ is the sigmoid activation function.




- (•) $a_1^{(3)} = g(\Theta_{1,0}^{(2)} a_0^{(2)} + \Theta_{1,1}^{(2)} a_1^{(2)} + \Theta_{1,2}^{(2)} a_2^{(2)})$
- ( ) $a_1^{(3)} = g(\Theta_{1,0}^{(2)} a_0^{(1)} + \Theta_{1,1}^{(2)} a_1^{(1)} + \Theta_{1,2}^{(2)} a_2^{(1)})$
- ( ) $a_1^{(3)} = g(\Theta_{1,0}^{(1)} a_0^{(2)} + \Theta_{1,1}^{(1)} a_1^{(2)} + \Theta_{1,2}^{(1)} a_2^{(2)})$
- ( ) $a_1^{(3)} = g(\Theta_{2,0}^{(2)} a_0^{(2)} + \Theta_{2,1}^{(2)} a_1^{(2)} + \Theta_{2,2}^{(2)} a_2^{(2)})$

1 point

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:

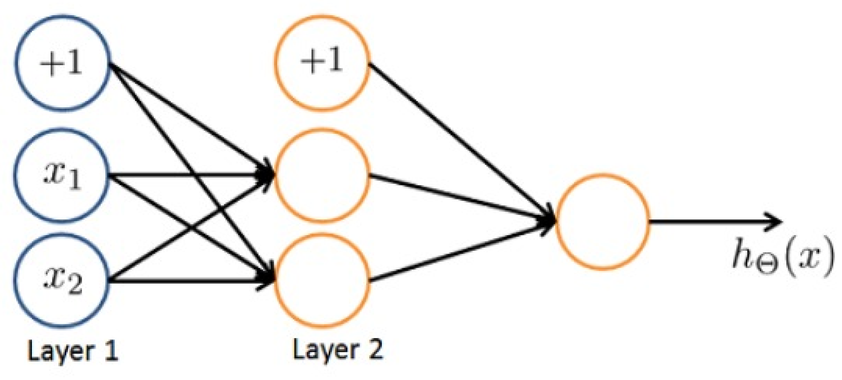
```
% Theta1 is Theta with superscript "(1)" from lecture
% ie, the matrix of parameters for the mapping from layer 1 (input) to layer 2
% Theta1 has size 3x3
% Assume 'sigmoid' is a built-in function to compute 1 / (1 + exp(-z))

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.

- [x] a2 = sigmoid (Theta1 * x);
- [ ] a2 = sigmoid (x * Theta1);
- [ ] a2 = sigmoid (Theta2 * x);
- [ ] z = sigmoid(x); a2 = Theta1 * z;

1 point

5. You are using the neural network pictured below and have learned the parameters $\Theta^{(1)} = \begin{bmatrix} 1 & -1.5 & 3.7 \\ 1 & 5.1 & 2.3 \end{bmatrix}$ (used to compute $a^{(2)}$) and $\Theta^{(2)} = [1 \quad 0.6 \quad -0.8]$ (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 $\Theta^{(1)} = \begin{bmatrix} 1 & 5.1 & 2.3 \\ 1 & -1.5 & 3.7 \end{bmatrix}$ and also swap the output layer so $\Theta^{(2)} = [1 \quad -0.8 \quad 0.6]$. 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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