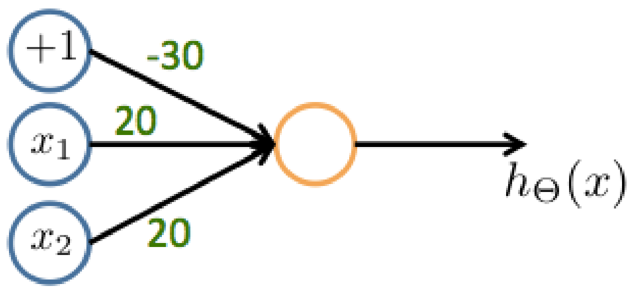
Feedback — VIII. Neural Networks: Representation

You submitted this quiz on **Mon 11 Nov 2013 7:25 PM PST**. You got a score of **4.00** out of **5.00**. You can attempt again in 10 minutes.

Question 1

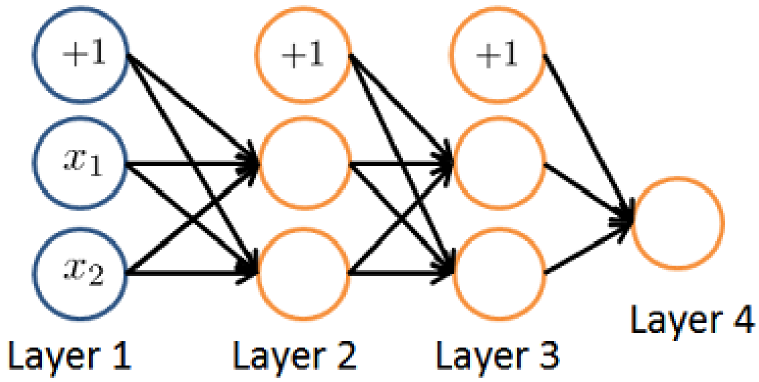
Consider the following neural network which takes two binary-valued inputs $x_1, x_2 \in \{0, 1\}$ and outputs $h_\Theta(x)$. Which of the following logical functions does it (approximately) compute?



Your Answer		Score	Explanation
XOR (exclusive OR)			
OR			
NAND (meaning "NOT AND")			
AND	✔	1.00	This network outputs approximately 1 only when both inputs are 1.
Total		1.00 / 1.00	

Question 2

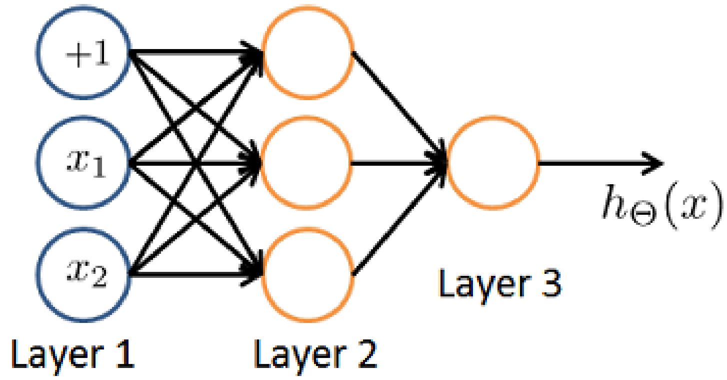
Consider the neural network given below. Which of the following equations correctly computes the activation $a_1^{(3)}$? Note: $g(z)$ is the sigmoid activation function.



Your Answer		Score	Explanation
$a_1^{(3)} = g(\Theta_{1,0}^{(2)}a_0^{(1)} + \Theta_{1,1}^{(2)}a_1^{(1)} + \Theta_{1,2}^{(2)}a_2^{(1)})$			
$a_1^{(3)} = g(\Theta_{1,0}^{(1)}a_0^{(1)} + \Theta_{1,1}^{(1)}a_1^{(1)} + \Theta_{1,2}^{(1)}a_2^{(1)})$			
$a_1^{(3)} = g(\Theta_{2,0}^{(2)}a_0^{(2)} + \Theta_{2,1}^{(2)}a_1^{(2)} + \Theta_{2,2}^{(2)}a_2^{(2)})$			
$a_1^{(3)} = g(\Theta_{1,0}^{(2)}a_0^{(2)} + \Theta_{1,1}^{(2)}a_1^{(2)} + \Theta_{1,2}^{(2)}a_2^{(2)})$	✔	1.00	This correctly uses the first row of $\Theta^{(2)}$ and includes the "+1" term of $a_0^{(2)}$.
Total		1.00 / 1.00	

Question 3

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
```

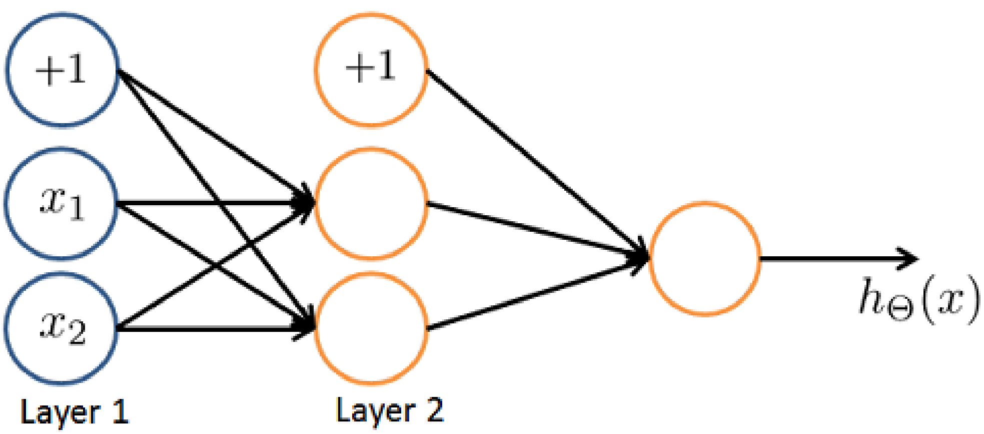
You want to have a vectorized implementation of this (i.e., one that does not use for loops). Which of the following implementations correctly compute $a^{(2)}$? Check all that apply.

Your Answer		Score	Explanation
☐ z = sigmoid(x); a2 = Theta1 * z;	✔	0.25	You should apply the sigmoid function after multiplying with $\Theta^{(1)}$, not before.
☐ a2 = sigmoid (x * Theta1);	✔	0.25	The order of the multiplication is important, this will not work as x is a vector of size 3×1 while Theta1 is a matrix of size $3x3$.
☐ z = sigmoid(x); a2 = sigmoid (Theta1 * z);	✔	0.25	You do not need to apply the sigmoid function to the inputs.

☑ a2 = sigmoid (Thet a1 * x);	✔	0.25	In the lecture's notation, $a^{(2)} = g(\Theta^{(1)}x)$, so this version computes it directly, as the sigmoid function will act element-wise.
Total		1.00 / 1.00	

Question 4

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 $h_\Theta(x)$?



Your Answer		Score	Explanation
◉ Insufficient information to tell: it may increase or decrease.	✖	0.00	Swapping $\Theta^{(1)}$ swaps the hidden layers output $a^{(2)}$. But the swap of $\Theta^{(2)}$ cancels out the change, so we can be certain the output will remain unchanged.
○ It will decrease			
○ It will increase.			
○ It will stay the same.			

Total	0.00 / 1.00

Question 5

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

Your Answer		Score	Explanation
☑ Any logical function over binary-valued (0 or 1) inputs x_1 and x_2 can be (approximately) represented using some neural network.	✔	0.25	Since we can build the basic AND, OR, and NOT functions with a two layer network, we can (approximately) represent any logical function by composing these basic functions over multiple layers.
☐ 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 $a_1^{(3)} + a_2^{(3)} + a_3^{(3)} = 1$.	✔	0.25	The outputs of a neural network are not probabilities, so their sum need not be 1.
☑ In a neural network with many layers, we think of each successive layer as being able to use the earlier layers as features, so as to be able to compute increasingly complex functions.	✔	0.25	Each layer computes a non-linear function of its input, so successive layers see more and more complex transformations of the original input.
☐ A two layer (one input layer, one output layer;	✔	0.25	We must compose multiple logical operations by using a hidden layer to represent the XOR function.

no hidden layer) neural network can represent the XOR function.	
Total	1.00 / 1.00