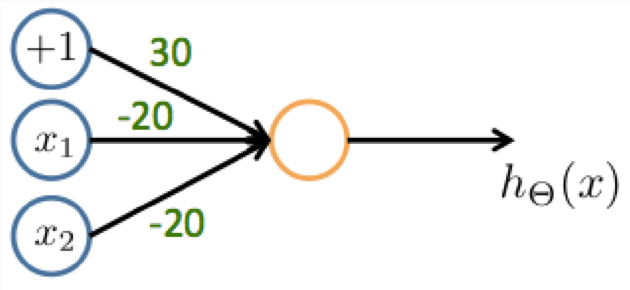
Feedback — VIII. Neural Networks: Representation

You submitted this quiz on **Sun 13 Apr 2014 2:45 PM IST**. You got a score of **5.00** out of **5.00**.

Question 1

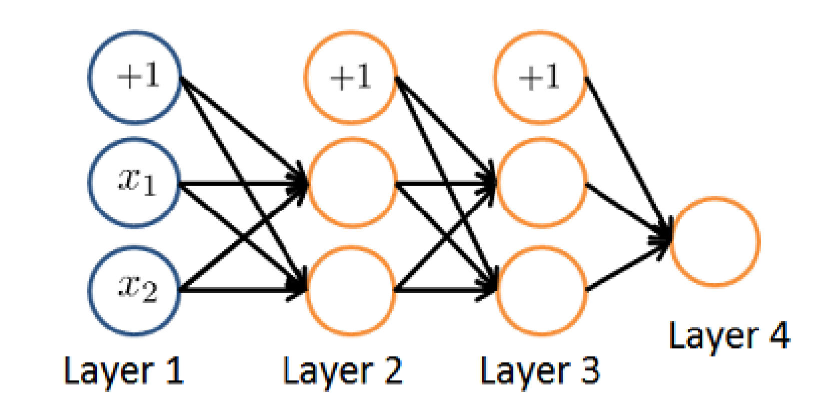
Consider the following neural network which takes two binary-valued inputs $x_1, x_2 \in \{0, 1\}$ and outputs $h_\Theta(x)$. Which of the following logical functions does it (approximately) compute?



Your Answer		Score	Explanation
XOR (exclusive OR)			
NAND (meaning "NOT AND")	✔	1.00	This network outputs approximately 1 as long as one of the two inputs is 0.
OR			
AND			
Total		1.00 / 1.00	

Question 2

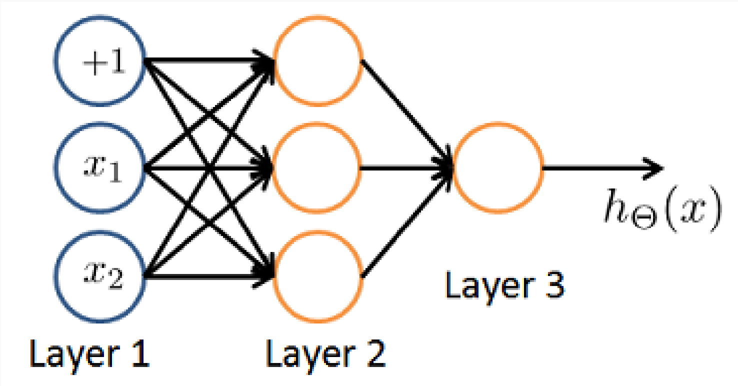
Consider the neural network given below. Which of the following equations correctly computes the activation $a_1^{(3)}$? Note: $g(z)$ is the sigmoid activation function.



Your Answer		Score	Explanation
$a_1^{(3)} = g(\Theta_{1,0}^{(2)}a_0^{(2)} + \Theta_{1,1}^{(2)}a_1^{(2)} + \Theta_{1,2}^{(2)}a_2^{(2)})$	✔	1.00	This correctly uses the first row of $\Theta^{(2)}$ and includes the "+1" term of $a_0^{(2)}$.
$a_1^{(3)} = g(\Theta_{1,0}^{(1)}a_0^{(1)} + \Theta_{1,1}^{(1)}a_1^{(1)} + \Theta_{1,2}^{(1)}a_2^{(1)})$			
$a_1^{(3)} = g(\Theta_{1,0}^{(2)}a_0^{(1)} + \Theta_{1,1}^{(2)}a_1^{(1)} + \Theta_{1,2}^{(2)}a_2^{(1)})$			
The activation $a_1^{(3)}$ is not present in this network.			
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:

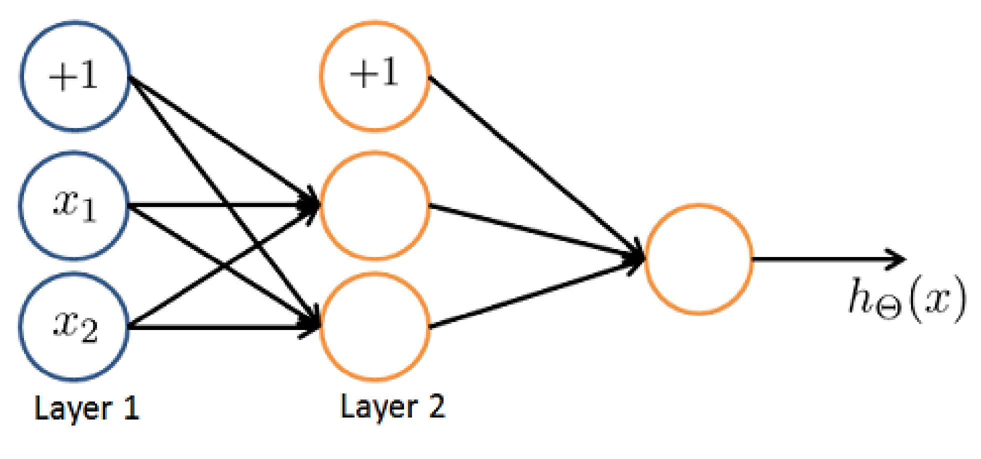
```
% Theta1 is Theta with superscript "(1)" from lecture
% ie, the matrix of parameters for the mapping from layer 1 (input) to layer 2
% Theta1 has size 3x3
% Assume 'sigmoid' is a built-in function to compute 1 / (1 + exp(-z))

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
☑ a2 = sigmoid (Theta1 * 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.
☐ z = sigmoid(x); a2 = sigmoid (Theta1 * z);	✔	0.25	You do not need to apply the sigmoid function to the inputs.
☐ a2 = sigmoid (Theta2 * x);	✔	0.25	$\Theta^{(2)}$ specifies the parameters from the second to third layers, not first to second.
☐ 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 $3x3$.
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 $\Theta^{(2)} = \begin{bmatrix} 1 & 0.6 & -0.8 \end{bmatrix}$ (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 $\Theta^{(1)} = \begin{bmatrix} 1 & 5.1 & 2.3 \\ 1 & -1.5 & 3.7 \end{bmatrix}$ 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
◉ It will stay the same.	✔	1.00	Swapping $\Theta^{(1)}$ swaps the hidden layers output a^{(2)}. But the swap of $\Theta^{(2)}$ cancels out the change, so the output will remain unchanged.
○ It will decrease			
○ Insufficient information to tell: it may increase or decrease.			
○ It will increase.			
Total		1.00 / 1.00	

Question 5

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

Your Answer		Score	Explanation
☐ A two layer (one input layer, one output layer; no hidden layer) neural network can represent the XOR function.	✔	0.25	We must compose multiple logical operations by using a hidden layer to represent the XOR function.
☑ The activation values of	✔	0.25	

the hidden units in a neural network, with the sigmoid activation function applied at every layer, are always in the range (0, 1).			The activation function $g(z) = \frac{1}{1+exp(-z)}$ has a range of (0, 1).
☐ 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.
☑ 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.
Total		1.00 / 1.00	