

NAME: \_\_\_\_\_

Select the best response for each question (6 questions, 1 point each). 4 free bonus points. 10 total.

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1. An artificial neuron with inputs  $x_i$  and output  $y$  is governed by the following mathematical equations:

$$v = \sum_i w_i x_i + b \quad y = f(v)$$

The weights and bias are  $w_1 = 1, w_2 = 0.5, b = -3$ . When  $x_1 = 1$  and  $x_2 = 2$ , the output  $y \approx -0.76$ .

Of the choices below, which is the most likely form of the activation function?

- ① hyperbolic tangent,  $f(v) = \tanh(v)$
- ② rectified linear,  $f(v) = \max(0, v)$
- ③ linear,  $f(v) = v$
- ④ quadratic,  $f(v) = v^2$
- ⑤ binary threshold,  $f(v) = 1, \text{ if } v \geq 0; f(v) = 0, \text{ if } v < 0$

2. A student tries to solve the following four classification problems using a perceptron with two inputs  $x_1$  and  $x_2$ . Each classification problem is represented by a table giving the possible input values and the desired class output.

Problem A

$x_1$	$x_2$	class
0	0	0
0	1	1
1	0	1
1	1	1

Problem B

$x_1$	$x_2$	class
0	0	1
0	1	0
1	0	0
1	1	1

Problem C

$x_1$	$x_2$	class
0	0	0
0	1	1
1	0	0
1	1	1

Problem D

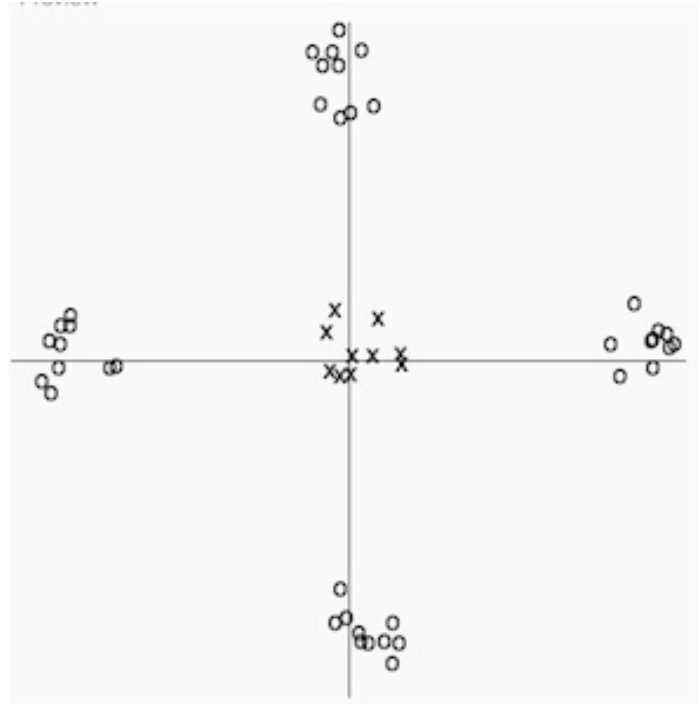
$x_1$	$x_2$	class
0	0	1
0	1	1
1	0	1
1	1	0

How many of these classification problems can be solved successfully using this approach?

- ① 1
- ② 2
- ③ 3
- ④ 4

3. A ConvNetJS neural network with one hidden layer is used to perform classification on the data shown below. What is the minimum number of hidden units required for the network to be able to correctly classify the 'x's and 'o's into two distinct classes?

- ① 1
- ② 2
- ③ 3
- ④ 4
- ⑤ 5
- ⑥ 6



4. The ConvNetJS library is used to create a neural network with two hidden layers to solve a classification problem. The layer definitions are as follows:

```
layer_defs = [];
layer_defs.push({type:'input', out_sx:1, out_sy:1, out_depth:5});
layer_defs.push({type:'fc', num_neurons:4, activation: 'relu'});
layer_defs.push({type:'fc', num_neurons:3, activation: 'relu'});
layer_defs.push({type:'softmax', num_classes:2});
```

In this network, how many total connections are there between the two hidden layers?

- ① 3
- ② 4
- ③ 5
- ④ 9
- ⑤ 10
- ⑥ 12

5. In the research described by Mnih et al. (2015) “Human-level control through deep reinforcement learning” they used a deep neural network to approximate the Q-value function. In their approach the input to the network was \_\_\_\_\_ and the output of the network was \_\_\_\_\_.

- ① an action  $a$ ; the Q-value for that action in the current state
- ② the state  $s$ ; the maximum Q-value in that state across all possible actions
- ③ the state  $s$  and an action  $a$ ; the Q-value for that state-action pair
- ④ the state  $s$ ; the Q-values for each possible action
- ⑤ an action  $a$ ; the Q-values for each possible state

6. In Homework 12, the paddle has four ball sensors [leftRed, leftGreen, rightRed, rightGreen]. Green balls are good (+1), red are bad (-1). The sensor values increase as the ball gets closer to the sensor. The sensors are located at the two ends of the paddle. There are at most two balls on the screen at any given time. For the following sensor reading, what is likely the best action for the paddle?

[leftRed, leftGreen, rightRed, rightGreen] = [0.49, 0.15, 0.51, 0.23]

- ① move left
- ② move right
- ③ stop

===== END OF QUIZ =====