Review Test Submission: Mid-Term Exam Part A

User	BRIAN THOMAS LOUGHRAN
Course	EN.605.647.81.SP21 Neural Networks
Test	Mid-Term Exam Part A
Started	4/11/21 3:20 PM
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Status	Completed
Attempt Score	Grade not available.
Time Elapsed	11 minutes out of 1 hour
Instructions	Here are the instructions.
Results Displayed	Submitted Answers, Incorrectly Answered Questions

Question 1

5 out of 5 points

Given the perceptron diagrammed in Problem 1, Problem Reference A (P1:PR-A) and the activation function y in P1:PR-B and the error function in P1:PR-B, where the inputs to the network are $I_1 = 0.8$ and $I_2 = 0.9$, the bias is 0 and the initial weights are $w_1 = 0.5$ and $w_2 = 0.5$, what is the **activity** function value?

Selected Answer: 0.85

Question 2

5 out of 5 points

For problem 1, what is the activation function value?

Selected Answer: 0.9219

Question 3

0 out of 5 points

Using the equations for Problem 1, determine the gradient vector element corresponding to w_1 where the desired output is 0.2. That is, determine the partial derivative of E with respect to w_1. **Hint:** You will first have to derive an expression for the gradient vector elements.

Selected Answer: -0.3007

Question 4

0 out of 5 points

Now calculate the gradient vector element associated with w_2.

Selected Answer: -0.3383

Question 5

0 out of 5 points

For Problem 1 and using your calculations for the gradient vector elements, calculate the updated weight w_1 based on the method of steepest descent where eta = 0.1.

Selected Answer: 0.4699

Question 6

0 out of 5 points

Ok, now calculate the updated weight w_2 by applying the method of steepest descent again with eta = 0.1.

Selected Answer: .4661

Question 7

5 out of 5 points

Recall the Perceptron Delta Function where we determine an updated weight. For a single perceptron with two inputs both equal to 1/2 and initial weights of 0.75 and 0.5, respectively, and a bias $\theta = 3$, with the usual linear activity function and Sigmoid activation function, a desired output of 0.6 and $\eta = 2$, determine the updated **bias** value. **Hint:** This will require you to derive the partial derivative of E with respect to the bias θ. Answer to 4 decimal digits.

Selected Answer: 2.9810

Question 8

2 out of 2 points

Detective Trig is working on several cases involving racketeering and criminal gangs and developed a neural network classifier depicted by the graphic below. Detective Trig wants to detect (naturally) members of a criminal gang and created a detector that identifies members of a criminal gang when a person has certain numerical attributes corresponding to the values x_1 and x_2. In the graphic in P2:PR-A, criminal gang members' attributes are symbolized with the symbol '+' while the attributes of other innocent persons (yeah, right!) are symbolized by a 'o' corresponding to attribute values of informants, potential informants or people who lack criminal intent.

The graphic in P2:PR-A has vertices D, E and F with coordinates (4,8), (1,2) and (8,2), respectively and is based on a four perceptron neural network with a hidden layer comprised of three perceptrons corresponding to edges DE, EF and DF and a single output perceptron that performs the logic AND operation and outputs a 1 if and only if all of its input values are 1. The detector is designed to output a 1 when input parameters (x_1, x_2) correspond to points on the interior of the triangle. Each perceptron has an activity function of the form shown in P2:PR-B and a threshold-logic function shown in P2:PR-C.

The detector works pretty well and detects all gang members with one exception corresponding to a really nasty gang member with parameters (8,6). Using this information, answer the following questions:

What is the number of True Positives?

Selected Answer: 6

Question 9

2 out of 2 points

What is the number of True Negatives?

Selected Answer: 4

Question 10

2 out of 2 points

What is the number of False Positives?

Selected Answer: 0

Question 11

2 out of 2 points

What is the number of False Negatives?

Selected Answer: 1

Question 12

3 out of 3 points

What is the current sensitivity of the detector?

Selected Answer: 0.8571

Question 13

3 out of 3 points

What is the specificity of the detector?

Selected Answer: 1

Question 14

5 out of 5 points

Detective Trig wants to increase the sensitivity to 100% by changing just the perceptron associated with line segment **DF (P2,PRA)**. This perceptron currently has weights for x_1, x_2 of 0.75 and 0.5, respectively, and a bias of -3. Keeping the weights and the threshold value the same, what is the greatest value of the bias that enables the detector to detect the nasty gang member? **Hint:** You will need to use (or compute) the activity value associated with the original position of the line segment **D-F.**

Selected Answer: -5

Question 15

5 out of 5 points

Consider the graphic in P3:PR-A. Suppose one is trying to develop a feed-forward neural network using perceptrons and their innate capacity of linear separability to design the network so that it outputs a 1 when the inputs x_1 and x_2 correspond to points in the shaded region and outputs a 0 for all other points.
Assuming a perceptron can model the logic functions of 'OR', 'Not OR', 'AND' and 'Not AND', what is the minimum number of perceptrons required to implement the network.

Selected Answer: 9

Question 16

5 out of 5 points

In the previous problem, how many layers of perceptrons in the network would be necessary?

Selected Answer: 3

Sunday, April 11, 2021 3:32:27 PM EDT

← OK