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**EN.605.647.83.SP21** Neural Networks

Course Modules

Midterm Examination

BRIAN LOUGHRAN 13 🔻 Review Test Submission: Mid-Term

Exam Part A

## 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
Submitted	4/11/21 3:32 PM
Due Date	4/11/21 11:59 PM
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 Ouestions

**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



 $\frac{1}{2}$  Using the equations for Problem 1, determine the gradient vector element corresponding to  $w_1$  where the  $^{igstyle{ imes}}$  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 w2.

Selected Answer: -0.3383 **Question 5** 0 out of 5 points



 $\longrightarrow$  For Problem 1 and using your calculations for the gradient vector elements, calculate the updated weight  $w_1$  $\mathbf{X}$  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  $\theta$ . 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:

**Question 9** 2 out of 2 points



What is the number of True Negatives?

Selected Answer:

**Question 10** 2 out of 2 points



What is the number of False Positives?

Selected Answer:

**Question 11** 2 out of 2 points



What is the number of False Negatives?

Selected Answer:

**Question 12** 3 out of 3 points



What is the current sensitivity of the detector?

Selected Answer: 0.8571

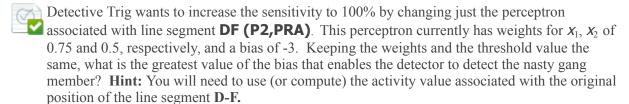
**Question 13** 3 out of 3 points



What is the specificity of the detector?

Selected Answer:

**Question 14** 5 out of 5 points



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?

3 Selected Answer:

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

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