**AUM Computer Science – CSCI 6450 Machine Learning – Dr. Olcay Kursun – Fall 2025**

**Perceptron Assignment (Assignment 6)**

The perceptron illustrated below has been partially trained to approximate the AND function. The four points in the figure represent the four main blobs, with the yellow point indicating the positive class. The perceptron uses a sigmoid activation for this binary classification task. Through training, the perceptron has learned to form a decision boundary (shown in blue color) at approximately a -53-degree angle, reminiscent of the famous 3-4-5 triangle, with an intercept of 1.2. Answer the following questions based on this perceptron setup and the provided dataset.

A graph with red and yellow dots

Description automatically generated

Dataset of x1, x2, and r (expected output):

(x1, x2) r

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1. (0.1, 0.2) 0

2. (-0.1, 1.1) 0

3. (1.1, -0.2) 0

4. (0.9, 1.0) 1

5. (0.8, -0.1) 0

6. (1.1, 1.3) 1

Questions:

Q1-Q2-Q3: What are the Perceptron Parameters w0, w1, and w2? To obtain a unique solution, give your answer such that w1^2+w2^2 = 1. Only after computing everything, while reporting your final numbers, round them to the nearest tenth (one digit after the decimal point). For example, if the answer was w0=-1.529, w1=0.61, and w2=0.81 then you can enter:

-1.5

0.6

0.8

Q4-Q5-Q6: Using the same figure/plot, what if the separating line was rotated counter-clockwise to -45 degree slope (shown in orange color). What are the Perceptron’s weights (parameters) w0, w1, and w2 are now? To obtain a unique solution, give your answer such that w1^2+w2^2 = 1. Only after computing everything, round your final weights to the nearest tenth.

Q7: What is the accuracy of the blue model on the dataset? After computing your answer, round it to the nearest percentage (e.g., if you have 4 out of 6 correctly classified then your answer should be “67” because it will be rounded up from 66.66%).

Q8: What is the average loss of the orange model on the dataset? Add all the loss values (use log-loss, aka binary cross-entropy) and then divide by 6. After computing your final answer, round your answer to the nearest hundredth.

Q9-Q10-Q11: Given the training example x1=1, x2=0, and r=0, suppose the perceptron’s weighted sum, a, is 1.4 (so it misclassifies this particular example). What are the weight changes  and  after performing one update on this example with a learning rate of ? After computing your final answers (delta-w0, delta-w1, delta-w2), round them to the nearest hundredth.