**CPE383 Machine Learning: Quiz 7**

1. 15 points. 1 hour. Show that the OR, AND will work for a single layer perceptron, but the XOR will not find a solution.

The AND and OR logical operations can be modeled using a single-layer perceptron with linearly separable input data. For example, in the case of the AND operation, if we represent the two input variables as x1 and x2, we can set the weights w1 and w2 of the perceptron such that w1 + w2 > 1.0, and set the bias term b to be negative. This will cause the perceptron to output a positive value only when both inputs are positive, which is the desired behavior for the AND operation. Similarly, we can set the weights and bias term for the OR operation to produce the desired output.

However, the XOR logical operation is not linearly separable, and cannot be modeled by a single-layer perceptron. This is because no matter how we set the weights and biases, we cannot draw a straight line that can perfectly separate the two classes of input data (i.e., those that produce a 0 output and those that produce a 1 output). Therefore, we need to use a multi-layer perceptron or some other non-linear classifier to model the XOR operation.

OR

|  |  |  |
| --- | --- | --- |
| In1 | In2 | out |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

AND

|  |  |  |
| --- | --- | --- |
| In1 | In2 | out |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

XOR

the XOR logical function is not linearly separable. The inputs are binary values, and the output is 1 only if one of the inputs is 1, but not both. the OR and AND logical functions will work for a single layer perceptron because they are linearly separable, but the XOR function will not find a solution because it is not linearly separable.

|  |  |  |
| --- | --- | --- |
| In1 | In2 | out |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

1. 15 points. 1 hour. Use multilayer perceptron on sklearn’s diabetes data meant for regression using 25% test data, find the R-square.

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1. 20 points. 2 hours. Follow the instructions in the following site for MLPClassifier for MNIST data. <https://towardsdatascience.com/classifying-handwritten-digits-using-a-multilayer-perceptron-class> ifier-mlp-bc8453655880 . Use 50,000 data samples for training and 20,000 for testing. Note you should scale your data to be 0-1 by dividing it by 255. Report your accuracy and print out the confusion matrix. Text

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2. 10 points. 0.5 hours. Repeat problem #3, but also normalize the input data by dividing by variance on the scaled 0-1 data by using sklearn’s StandardScaler. Report your accuracy and see if it improves from problem #3. Text

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ANS The accuracy drops a little bit