Exercise 5

Do not use existing implementations of perceptron algorithm for following tasks.

1. Implement perceptron classifier, and use it to classify AND, OR and XOR data shown below (in same order). You can start algorithm with small random weights. Stop algorithm after fixed number of iterations. A correct implementation should achieve 100% accuracy with AND and OR data, but not with XOR data. Why algorithm does not reach 100% accuracy with XOR data? Visualize/Report what happens to perceptron weights if you keep updating them for XOR data.

X	Y	Class		X	Y	Class		X	Y	Class
0	0	0		0	0	0		0	0	0
1	0	0		1	0	1		1	0	1
0	1	0		0	1	1		0	1	1
1	1	1		1	1	1		1	1	0

2. Recall **bogus_student_data.txt** data. Train a perceptron to classify students with grades 0, 1 or 2 from the rest based on the exercise and exam points. Adjust learning rate, number of iterations and initial weights to reach 80% or higher accuracy.[1] Visualize learned weights by drawing the data and the learned decision boundary. Do you think the learned weights are good? Could they be better? Why the learning algorithm did not reach higher accuracy (if it was below 99%)?

   Hint for visualization: The decision boundary is the line $w_0 + w_1x_1 + w_2x_2 = 0$, where x_1 and x_2 are the input variables (exercise and exam points). Fix x_1 and solve for x_2.

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[1] Perceptron can reach $\approx$ 100% accuracy with correct parameters, but 80% is enough for this task.