Machine Learning
Exercise 1

Exercise 1
Consider the linear function:

$$y_1(x_1, x_2) = 2 - \frac{2}{3}x_1 - x_2$$

- Draw in the (x_1, x_2)-coordinate system the hyperplane defined by $y_1(x_1, x_2) = 0$.
- Draw the vector $\boldsymbol{w} = (-\frac{2}{3}, -1)$ and verify that this vector is orthogonal to the hyperplane
- What is the decision region defined by $y_1(x_1, x_2) > 0$?

Exercise 2
We consider the example from lecture slide 1.32 (I use X.YY to denote the YY'th slide in lecture no. X).

- Compute the sum-of-squares errors of the two models $\boldsymbol{W}_1$ and $\boldsymbol{W}_3$.
- Find a solution $\boldsymbol{W}_3$ that has both 100% accuracy and a low sum-of-squares error.

Exercise 3
In addition to y_1 from Exercise 1, consider

$$y_2(x_1, x_2) = 3 + 3x_1 - x_2$$
$$y_3(x_1, x_2) = 1 + \tfrac{1}{10}x_1 - \tfrac{1}{4}x_2$$

- Assume that y_1, y_2, y_3 are three linear classifiers for the binary classifications "class a vs class b", "class a vs. class c", and "class b vs. class c" respectively. What are the decision regions for the resulting "one against one" classifier? Before you can answer this question, you will have to decide which decision regions are associated with which class, e.g., whether $y_1(x_1, x_2) < 0$ should mean that you classify (x_1, x_2) as a or b.
- Now assume that y_1, y_2, y_3 are three discriminant functions for the classes a, b, c. What are the decision regions for the resulting discriminant function classifier?