SVMs
Exercises

Exercise 1.

1. Describe in your own words the learning and classification process of a linear SVM.
2. What does a linear SVM optimize, and why?

Exercise 2.

Consider the following training dataset with classes -1 and 1:

$$S = \{(x_1, x_2; y_i)\} = \{(2, 0; -1), (0, 2; -1), (2, 2; 1), (3, 2; 1)\}$$

1. What is the geometric shape of the optimal hyperplane?
2. Determine the optimal hyperplane ($\boldsymbol{w}$ and b). Note: It is not necessary to setup a Lagrange function and run the optimization procedure. Just take a good look!
3. * Compute the width of the margin.
4. Classify the instance $(1, 4)$.
5. Which instances are support vectors?

Exercise 3.

1. Create an example of a dataset that is easily classifiable using a linear SVM.
2. Create an example of a dataset that is not classifiable using a linear SVM.

Exercise 4.

Create a Jupyter Notebook for predicting wine cultivars using SVMs.

1. Download the wine dataset from UCI Machine Learning Repository.
2. Load the dataset as a pandas data frame and assign it a proper header.
3. To create a binary problem restrict the rows to those with class 2 or 3
4. Split the dataset 50:50 into training and test data

5. Use the random seed 1 if you use random
6. Create a classification experiment for linear (soft-margin) SVMs
7. Investigate the impact of different choices of C on training and test accuracy (draw and interpret a suitable diagram)
8. Similarly compare the number of support vectors and the resulting margin for different choices of C
9. Which test accuracy do you achieve with the best parametrization?
10. Now experiment with the radial basis function and with the polynomial kernel. Here multiple hyperparameters must be selected.
    a) Fix $C = 100$ and vary γ for the radial basis function.
    b) Fix $C = 100$ and vary the degree for the polynomial kernel