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Webpage for the lecture: `https://mathopt.de/TEACHING/2020OMML/`

Optimization Methods for Machine Learning

WS 2020 – 2. exercise sheet

Exercise 1.1 (Wine classification)
Goals: *Getting used to and play with sklearn.*

1. Get the exercise template *ex02_temp.py* from our webpage *https://mathopt.de/TEACHING/2020OMML/* and go through the provided lines.
2. Split the dataset using `train_test_split` from `sklearn.model_selection`.
3. Print the *train set*.
4. Print the *train set* a second time by executing the script again. What do you observe?
5. Try out a *support vector machine* (`svm`) to classify the data. Use the *support vector classification* class (`svc`) inside `svm`.
   - Train the classifier with `fit` on the *train set*.
   - Predict the classes of the *test set* using `predict`.
   - Print the predictions and the ratio of success.
   - Discuss your findings!
6. Try out another classifiers: Use `DecisionTreeClassifier` from `tree`.
7. Compare the different classifiers. What could cause the problems with the *svc*?
8. Alter the `svc` function by providing optional parameters.

Exercise 2.2
Goals: *Lagrangian function*
Consider the optimization problem

$$\min_{x\in\mathbb{R}^d} c^T x + \frac{1}{2} x^T Q x \text{ s.t. } Ax \leq b, \tag{1}$$

where $c \in \mathbb{R}^d$, $Q \in \mathbb{S}^d_+$, $A \in \mathbb{R}^{m\times d}$ and $b \in \mathbb{R}^m$. State the Lagrangian function and KKT-conditions.

Exercise 2.3
Goals: *KKT-Conditions*
Consider the optimization problem

$$\min_{x_1,x_2} \; -x_1 - x_2 \quad \text{s.t.} \quad x_1^2 + x_2^2 - 1 = 0, \quad x_1, x_2 \geq 0. \tag{2}$$

Use KKT-conditions to determine all solutions of (2) with their corresponding Lagrange multipliers.