

Machine Learning

Exercise Sheet 1

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Exercise 1: R-Tutorial 1 (3 Punkte)

Install R: <http://www.r-project.org/>.

Download „An Introduction to R“ <http://cran.r-project.org/doc/manuals/R-intro.pdf>. Read Chapter 1 and reproduce the sample session in Appendix A (page 82). Create a screenshot during the session and add it to your solution.

Exercise 2: Linear Regression (7 Punkte)

a) Given are the data instances of the example from the lecture (gas consumption):

$$\mathcal{D} = \{(2, 6), (6, 5), (8, 4.5)\}$$

Estimate the target $\hat{y}(x) = \hat{\beta}_0 + \hat{\beta}_1 x$ for $x = 10$ using the method of least squares. The true value is $y = 2$. Estimate the error. Interpret the result. Create a plot of all distances and show for each data point the least square error.

b) In the lecture was proven for the simple linear regression that

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

minimizes the residual sums of squares (RSS).

Reconsider the proof and provide intermediate steps for the partial derivative.

Setting the derivative to zero is a necessary criterion for the existence of an extremum. Justify that the given solution is a global minimum.

c) Find the parameters $\hat{\beta}_0$ and $\hat{\beta}_1$ by minimizing the mean squared error

$$\text{MSE} = \frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}(x_i))^2$$

using gradient descent with a learning rate $\alpha = 0.01$ and initial parameters $\hat{\beta}_0 = 6$ and $\hat{\beta}_1 = -0.5$ for two iterations. Compute the MSE after each parameter update.