Exercise Sheet 1

Due: 31.10.2018, 10:00

Download the file **tvads.csv** from ISIS. The file consists oft two columns. The first column contains TV advertising costs (in 1000$), the second column contains the corresponding numbers of sold products (in 1000).

Exercise 1.1

Implement the gradient descent method for simple linear regression in one variable.

Exercise 1.2

Apply the linear regression implemented in Exercise 1.1 to the tvads-data. Determine a suitable learning rate. Specify this learning rate and create the following two plots:

- The tvads-data[1] with the initial (randomly chosen) and the final hypothesis.
- The error (MSE) as a function of the number of iterations.

Exercise 1.3

Explore the behavior of the gradient descent method in dependence of the learning rate. For this, conduct the following experiment: Use the learning rate from Exercise 1.2 and find additionally a learning rate that is too small and a learning rate that is too large. Apply the linear regression to the tvads-data for these three learning rates using the same initial hypothesis in each case. Plot the error (MSE) as a function of the number of iterations for all three learning rates into a single figure. Discuss your results.

Exercise 1.4

Let $x_1, \dots, x_m$ be drawn independently from a Bernoulli distribution with unknown parameter (success probability) p. Determine the maximum likelihood estimator $\hat{p}$ of p. Hint: set the derivative of the log-likelihood $l(p)$ to zero and solve for p.

[1] Data points can be plotted using a scatter plot (`plt.scatter(x,y)`).