# Machine Learning 2
# Exercise Sheet 5

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## Exercise 8: Voting, Averaging, Stacking (5 Points)

**a)** Three logistic regression models defined by the parameters

$$\theta_1 = \begin{pmatrix} -1 & 1 & 1 \end{pmatrix}^T$$
$$\theta_2 = \begin{pmatrix} 0 & 0 & 1 \end{pmatrix}^T$$
$$\theta_3 = \begin{pmatrix} 0 & 1 & 0 \end{pmatrix}^T$$

have been learned for a binary classification data set. What is the prediction for $x_1 = \begin{pmatrix} 0.2 & 0.2 \end{pmatrix}$ using voting and averaging, respectively.

**b)** Use the models from a) to apply linear stacking on the following data set.

| $x_1$ | $x_2$ | $y$ |
|---|---|---|
| 0.2 | 0.2 | + |
| 0 | 1 | - |
| 1 | 0 | - |

**c)** Compare a Neural Network with one hidden layer and a linear stacking of logistic regression models applied on a binary classification problem. What are commonalities, what are differences?

## Exercise 9: Random Forest (5 Points)

Given is following data set.

| ID | $x_1$ | $x_2$ | $x_3$ | $y$ |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | + |
| 2 | 1 | 1 | 0 | + |
| 3 | 0 | 1 | 1 | - |
| 4 | 0 | 0 | 0 | - |
| 5 | 1 | 0 | 1 | ? |
| 6 | 0 | 1 | 0 | ? |

Train a random forest with three decision stumps using the Gini Index as a splitting criterion. Use for the first stump instances 2 and 3 and features $x_2$ and $x_3$. For the second stump use instances 1 and 2 and features $x_1$ and $x_2$ and for the last stump use instances 3 and 4 and features $x_1$ and $x_3$. What are the predictions for instances 5 and 6? What are the predictions of a decision tree?