Exercises for
Pattern Recognition
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General Information:

Exercises (1 SWS):	Mo 12:15 – 13:30 (H10 lecture hall building) and Tue 08:45 – 10 (0.151-113)
Certificate:	Oral exam at the end of the semester
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Support Vector Machine & Constrained Optimization

Exercise 1 In this exercise, you will create a *Support Vector Machine* (SVM) classifier for a two-class problem. We perform classification in the original feature space (i.e. you don't need to apply kernel functions to lift the features into a space of higher dimensionality). Also, we solve the optimization in the primal form. For non-linear optimization, we suggest to apply the Matlab function `fmincon`, which provides the constrained optimization algorithm that is required to optimize the hyperplane. The caller to this function has to provide a handle to the objective function and a linear system of inequalities.

(a) Implement the SVM with hard margin constraints.

(b) Extend your implementation with soft margin constraints.

(c) Visualize the decision boundary of the SVM with hard/soft margin constraints for different training sets.

Exercise 2 Find the largest rectangle that can be inscribed in the ellipse $x^2 + 2 \cdot y^2 = 4$. In this example, it is sufficient to consider rectangles which are centered at the origin.

(a) What is the area of such rectangles? Formulate the constrained optimization problem.

(b) Solve using the Lagrange multiplier method.