Exercises, Lecture 5

1. Optimal Separating Hyperplanes

    a. Run the file `Exercise1a.m`. Play around with different choices of the kernel type (`'linear'`, `'polynomial'`, or `'gaussian'`) and the kernel parameter (the standard deviation for the Gaussian kernel or the degree for the polynomial kernel).
    b. Run the file `Exercise1b.m`. Try to find a value of the kernel parameter that leads to an acceptable separation between the two classes. What do you think about the generalization ability of your solution?

2. The file `Exercise2.m` contains code for building a support vector machine for some 2D data. As in the previous exercise, play around with different choices of kernels and parameters. Make sure you understand the results in terms of boundary complexity and margin size.

3. Convex optimization

    - Ridge regression is the solution to the minimization problem $\arg\min_\beta ||y - X\beta||^2 + \lambda||\beta||^2$. We found the solution during the second exercise. An equivalent formulation is $\arg\min_\beta ||y - X\beta||^2$ subject to $||\beta||^2 \leq t$, a quadratic problem with a quadratic constraint. Solve this convex constrained minimization problem via the following steps:

        I. Rewrite the constraint in the form $g(x) \leq 0$.

        II. Move the constraint into the minimization problem using a single Lagrange multiplier.

        III. Differentiate w.r.t. β and set to zero.

        IV. Solve for β.

      Does the result look familiar to you?

4. Use the support vector machine to build a classifier for the acute coronary syndrome data in `ACS.csv`. Tune a suitable model using 10-fold cross validation. Start with the skeleton in Exercise4.m where we split data in one training and one test set. We have also inserted a logistic regression model in the skeleton as comparator.
    - With logistic regression you get a accuracy around 0.84 - can you do better with SVM?