INF 4300 2014
Classification 3

Exercise 1.

You are given data from two classes with means and covariance as given below:

$$\mu_1 = \begin{bmatrix} 3 \\ 6 \end{bmatrix} \quad \Sigma_1 = \begin{bmatrix} 0.5 & 0 \\ 0 & 2 \end{bmatrix} \quad \Sigma_1^{-1} = \begin{bmatrix} 2 & 0 \\ 0 & 0.5 \end{bmatrix}$$

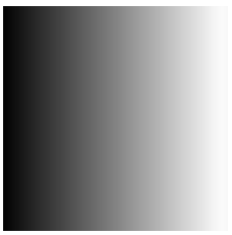
$$\mu_2 = \begin{bmatrix} 3 \\ -2 \end{bmatrix} \quad \Sigma_2 = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} \quad \Sigma_1^{-1} = \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix}$$

a) Compute the eigenvectors and eigenvalues of the covariance matrices (use Matlab if you want) and use them to sketch the ellipses for the covariance matrices in a plot.

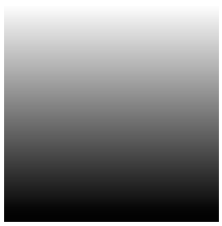
b) Show that the decision boundary (g1(x)=g2(x)) in this case with features x_1 and x_2 can be expressed as $x_2=3.514-1.125x_1+0.1875x_1^2$

c) Plot the resulting decision boundary in Matlab.

d) Create a synthetic image with 2 bands with samples that span the feature space from e.g. -10 to 10 for both features. For simplicity, let us just consider a coarse grid of samples on integer values (-10,-9,….,0,….9,10). Feature image 1 should look like a horisontal ramp from -10 to 10, and feature image 2 like a vertical ramp from 10 to -10:



Feature 1



Feature 2

This corresponds to creating feature vectors that span the entire feature space (from -10 to 10). If we later classify all these feature vectors, the resulting classification map should have the same decision boundary as the plot we computed in b) and plotted c). This is just a way to create a visualization of the decision boundary without computing it analytically.

e) Classify this image, and verify that the shape of the decision boundary you got in c) is the same as you get after classifying this image.

Exercise 2: Implement a kNN-classifier and test it on the Landsat TM-image from last week. Experiment with K, and compare the classification accuracy to a Gaussian classifier.