Pattern Recognition
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HW2

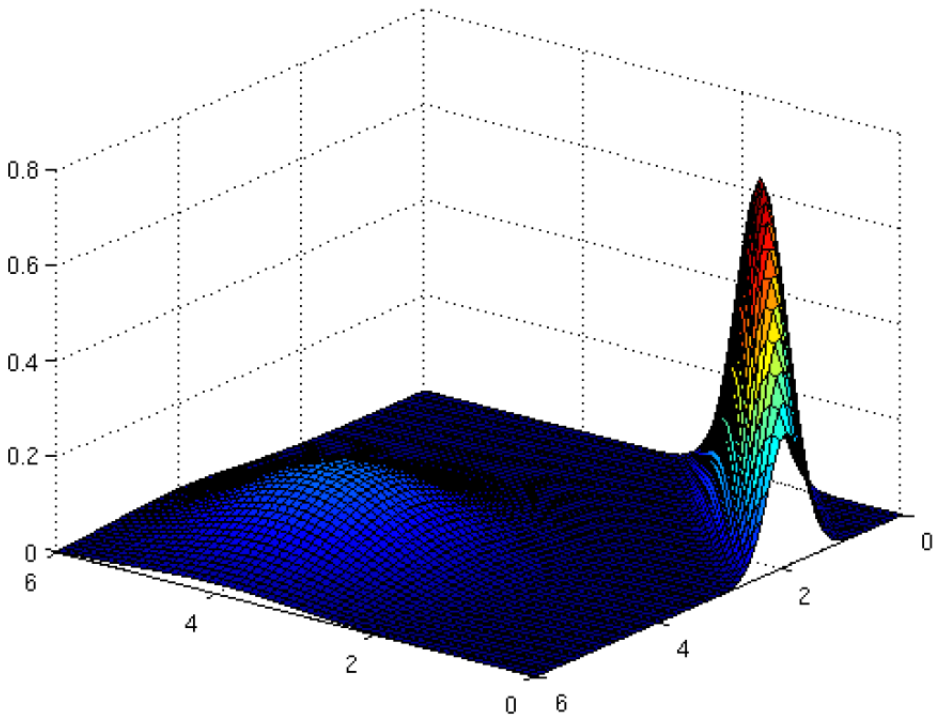
1. Euclidean distance vs. Mahalanobis distance

Suppose we have two 2D Gaussian distributions defined by $\mu_1 = (1\ 1)^t$ and $\mu_2 = (4\ 4)^t$ with covariances given by

S1=[0.475 −0.425
−0.425 0.475]

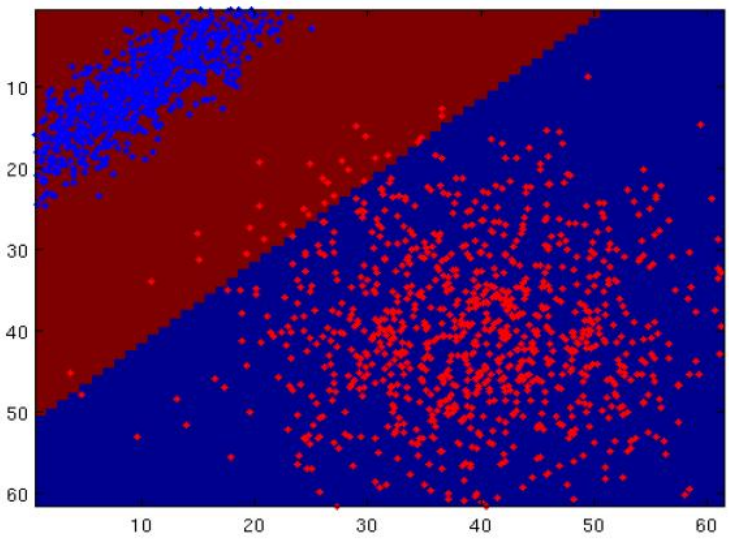
S2=[1 0
0 1]

- Use mgd.m (provided with this HW to generate 50 samples from each distribution and plot them.
- Estimate the mean and covariance from the sample, check if it matches the original one.
- Augment the number of samples to 1000 and see if the estimation error decreases.
- Plot the two distributions found using surf.



- Calculate the Euclidean distance between each point in the 2D feature space and the estimated mean of the two distributions.

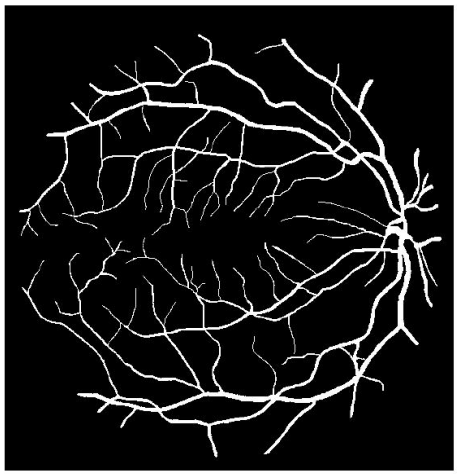
Using these distances, you should plot the areas that should belong to one class or the other as shown in the example output.
In this example the red area is the feature space closer to the mean of the blue samples, the blue area is the feature space closer to the red samples.



- Perform the same experiment employing the Mahalanobis distance.

2. NaiveBayes for segmentation

• You are going to try to automatically segment the vessel of a retina image using olour information only. On the left there is a fundus image on the right a manually generated vessel segmentation



- Load the training image 'training.tif' the vessel image 'training_vessels.gif' and the mask FOV 'training_mask.gif'
- Apply this function to preprocess the image and obtain three colour spaces:

```
function [imgEq, imgLabA, imgLabB] = preprocessImg(imgIn)
    % channels
    cform = makecform('srgb2lab');
    imgLab = applycform(imgIn,cform);
    imgLabA = imgLab(:,:,2);
    imgLabB = imgLab(:,:,3);
    imgG = imgLab(:,:,1);

    backgroundRed = double(medfilt2( imgG, [30 30] ));
    imgEq = double(imgG) - backgroundRed;
    imgEq( imgEq > 0) = 0;
    imgEq = -1*(imgEq);
end
```

- if it does not work on your Matlab version use:

```
function [imgEq, imgLabA, imgLabB] = preprocessImg(imgIn)
    % channels
    imgLabA = imgIn(:,:,1);
    imgLabB = imgIn(:,:,3);
    imgG = imgIn(:,:,2);

    backgroundRed = double(medfilt2( imgG, [30 30] ));
    imgEq = double(imgG) - backgroundRed;
    imgEq( imgEq > 0) = 0;
    imgEq = -1*(imgEq);

End
```

Create the positive and negative samples from the 3 colour spaces and with the vessel image and the mask image. Your feature space will be three dimensional. Remember that each pixel is a sample with 3 features, with a positive class if it lays to the vessels and negative otherwise.

- Plot the 1D histogram of each feature separately and evaluate the separability of the classes.
- Assuming a normal distribution of the samples train a NaiveBayes classifier.
- Use the NaiveBayes classifier to segment the vessels in the testing image 'test.tif'.
- Plot the resulting segmentation.