

**EE150**  
**Homework 1**  
**Due: Thurs, April 7**

## **1 ROC Curves**

A linear classifier was presented in class which has 2 parameters. Some of the code used to generate the ROC curves for these parameters is located on the class web-site.

1. What is the other parameter which can be varied? Create an ROC plot by varying the other parameter while keeping the other constant. Use the same data-sets Pietro used in class, Motorcycles and Faces. The Matlab function 'roc.m' is not provided. You will need to write it yourself. Explain the plot you observe. Compare this new ROC curve to the one presented in class. Which parameter do you feel yields a more useful ROC plot and why?

## **2 Classifiers**

A linear classifier was used for the experiments presented today in class to discriminate the classes Bikes vs. Faces. The color information from two locations within the image were used as 'features' for the classification. There are many other functional forms which the classifier can take, many other features which can be used, and many other classes we can test our experiments on. There are 101 different categories at the web address from which these images were loaded.

1. Experiments were done using the Face vs. Motorcycle classification task. There is another set of more difficult Face images in the directory 'Faces' at the web-site listed above which contain more background clutter (we saw the set 'Faces-easy' today in class). Re-run the classifier using this more difficult set of faces and plot the ROC curve. How does performance change?
2. Choose another arbitrary parameterized classifier which makes use of different information within the images. Be creative in choosing both the functional form of the classifier as well as the features which it uses. How are you finding the optimal parameter values for your classifier? Plot an ROC curve of your classifier by varying the parameter you feel is most informative. The ROC curve should compare 'Motorcycles' with the more difficult 'Faces' set. Try to obtain the best classifier possible and describe your reasoning.

3. Find the optimal values for your classifier using the 'Motorcycles' and the more difficult 'Faces' set. Now test the performance of your classifier using 'Motorcycles' and two other categories from the 101 categories, 'Buddha' and 'yin-yang'. Plot ROC curves for the test performance of your classifier on these classes. Is your classifier generalizing well to new classes?

### 3 Localization using Matched Filters

There are several different tasks we may be interested in for object recognition. Among these are (1) Classification and (2) Localization. The experiments above involved classification, determining which class a particular image belonged to. A method was presented today in class which allows for the localization of objects within an image using a matched filter.

1. Train a kernel for use in match filtering on the Faces-Easy data-set. How are you setting the threshold for detection? How are you constructing your kernel? Test it on the more difficult Faces data-set. Plot several examples (using the subplot command) of the best matched filter locations.
2. What could you do to make your match filter more robust to changes in lighting? Orientation? Size? What about occlusion?
3. Suppose I want to identify 'wheels' within images. Implement a matched filter which finds wheels. Describe how you create the kernel. Show results on the 'Motorcycles' and 'Cars Side' data-sets. Draw red boxes around hypothesized wheel detections. Try to get the best performance possible and describe your reasoning.