Computational Vision

Laboratory for face detection

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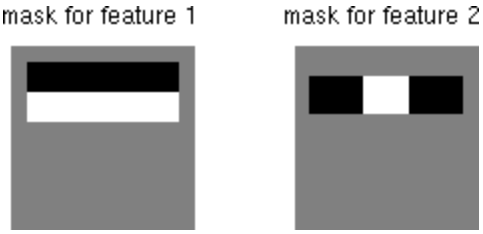
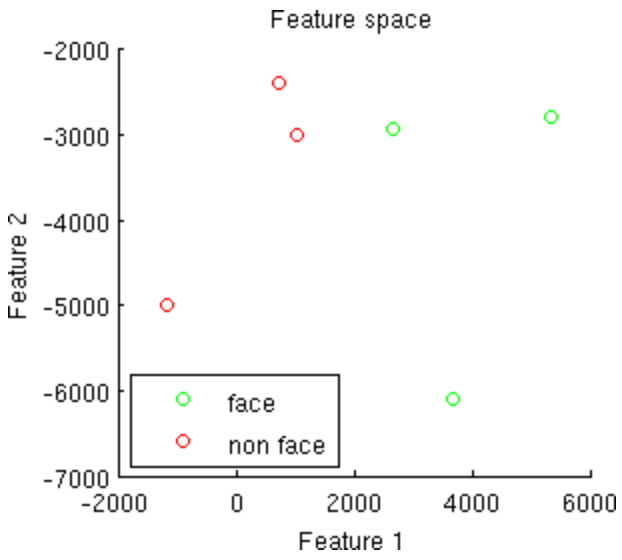
1. First exercise: compute and visualize Haar-like features

In this exercise we have computed the two different feature masks to see the differences between faces and non faces in this space.
This two mask seems to represent the different colors presents in usual faces. In the first mask we can see the region that delimits the eyebrows and the eyes. And in the second is the contrast between the eyes and the nose.



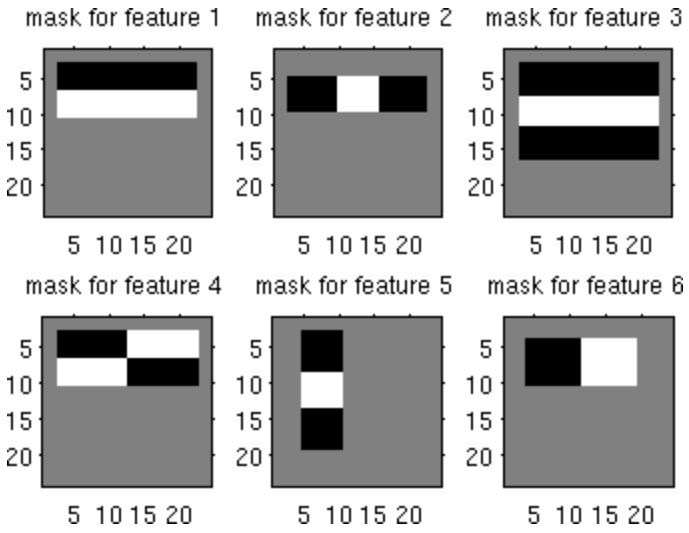
Then we selected six points on the picture, three of them in face areas and the others in non face areas. In the next picture is possible to see the selected points and inside the faces it is painted in blue the first mask.

In that case we can see that the features can divide the space linearly into faces and non faces. But these are not enough to do a classifier.



2. Second exercise: classification in the feature space

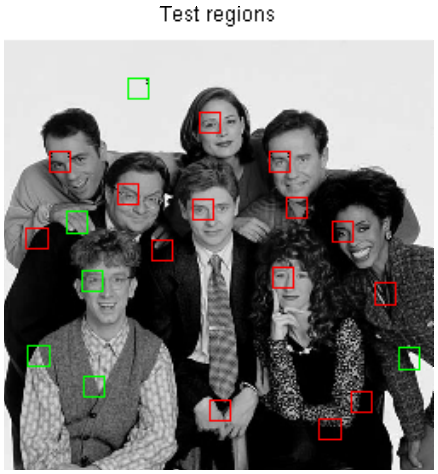
In this exercise we created six features, the first and the second are the same masks created in the exercise one. The last fourth are new features.

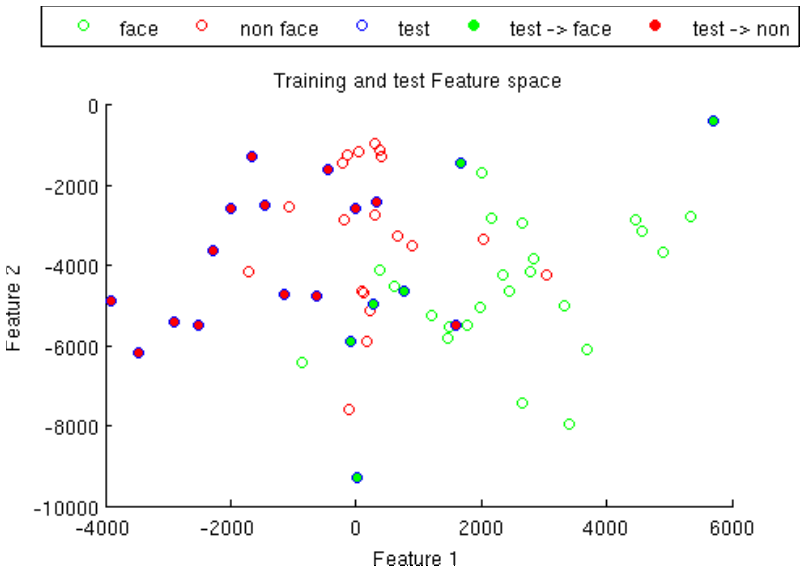


This time we have selected twenty regions with faces and twenty with none faces. These regions have been used to train a KNN space. Once this is done, we tested the KNN with new regions. In that case we used one picture of News Radio.

The KNN we used was with euclidean distances and 3 neighbors.
In this new picture the accuracy was very poor because the size of the faces in this image is larger. For this reason the regions do not fit to the faces. In the features dimensions it is possible to see the first and the second fetaures and the classification of the new points.

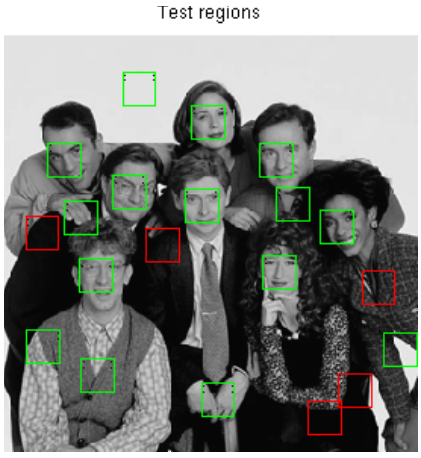
Original image of new radio:

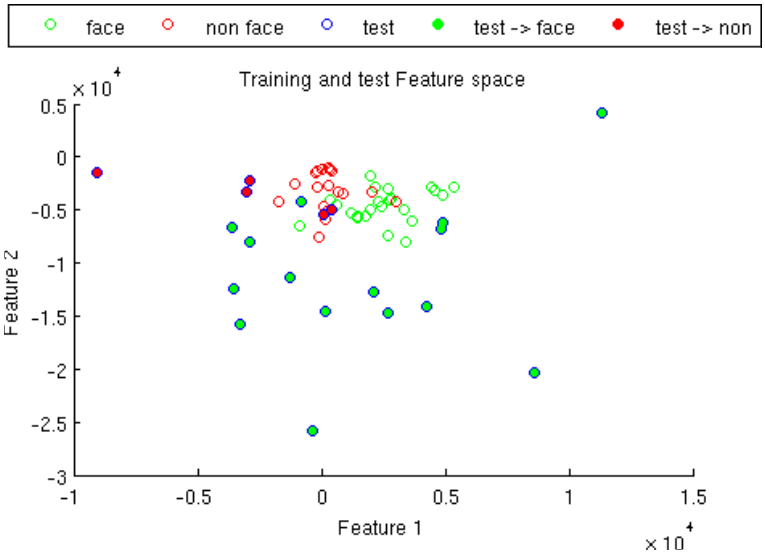




One approach to resolve the problem of the window dimension is to change the scale of the image. It is possible to search this windows in several scales and select the scales that identifies more faces. In this exercice we searched this scale manually trying 1:2, 3:5 and 3:10. With these diferent results we selected the best one that finally was 3:5.
This is the picture with this new scale and the results of classification.

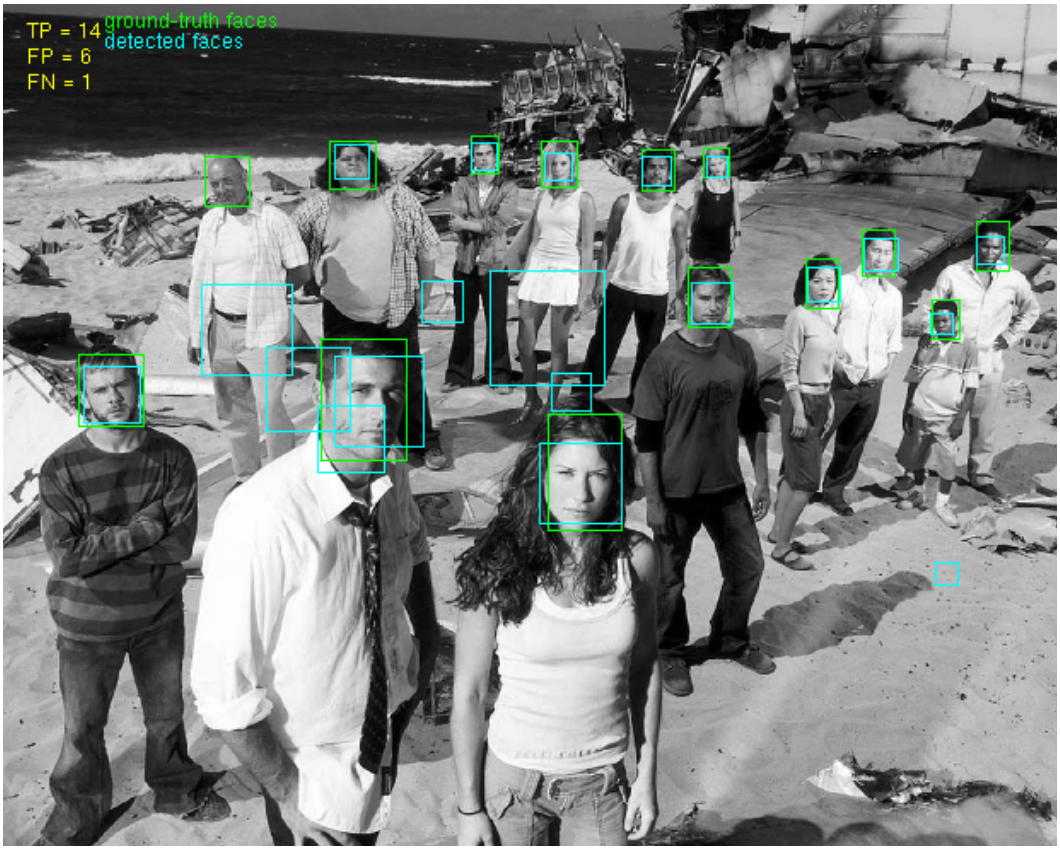
Escaled image of new radio on 0.6:





3. Third exercise: apply and evaluate Viola & Jones method on an image

In the third exercise we used the results from a Viola & Jones implementation in Matlab to evaluate the accuracy searching faces. We have used the True Positive, False Positive and False negative to evaluate with this results and some regions of the image selected by hand for all real faces.
In the next picture we can see in cyan the detected faces of the Viola & Jones implementation, and in green the areas selected by hand.
Finally at the upper left there are the number of true and false positives, and false negatives. In this kind of problems we want a larger number of true positives than false negatives, and in this example it is only one false negative in the upper left man.



4. Fourth exercise: apply and evaluate Viola & Jones method on a video

In this last exercise we analyzed the rate of face detection in a video of one hundred frames. Like the previous exercice, we used the results of Viola & Jones implementation for Matlab to evaluate the rate. Once again each frame have a real face region selected by hand and we can compute the true positives and the false negatives to compute the rate TP/(TP+FN).

And this is the result of computing the rate for each frame (in blue) and the average of all frames (in red).