2017

Face Detection and Recognition

COMPUTER VISION – LAB 5/6

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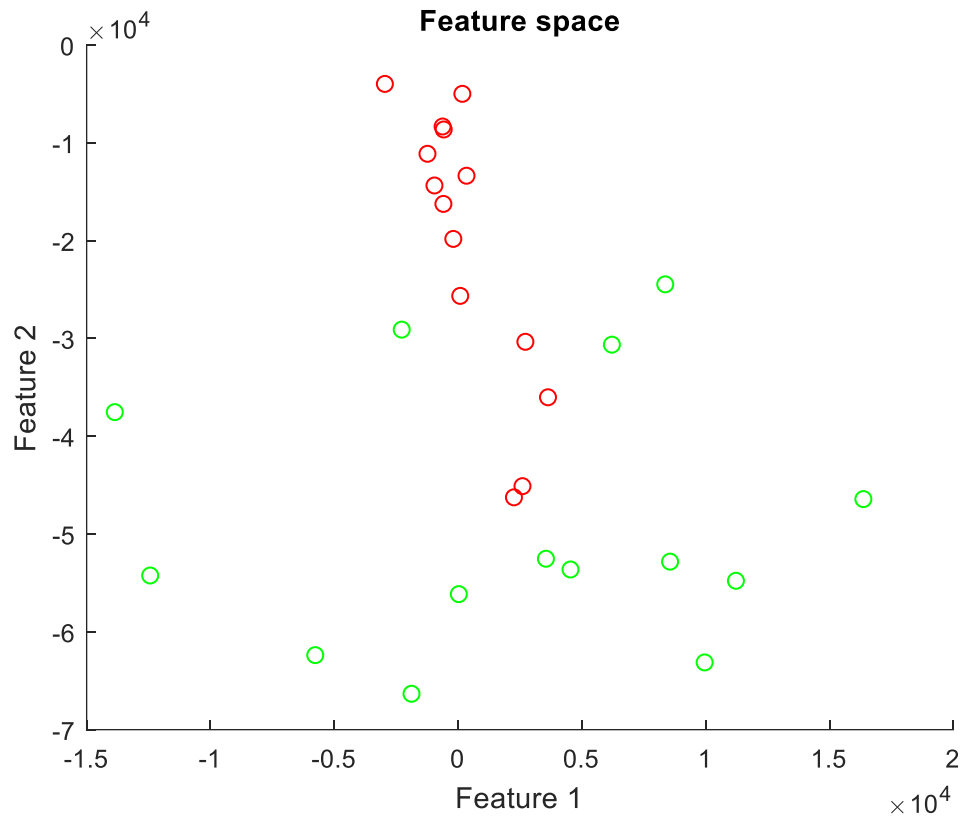BARCELONA

1- Integral images and Haar-like features

Figure 1: Feature space from image NASA1

Question 1:

The plot obtained in *Figure 1* give a representation of each of the rectangles as a function of the 2 Haar-like features. In green the rectangles that contain a face and in red the ones that do not.

As it can be observed, the red and green circles are fairly separated, so we can say that these features are appropriated to discriminate between faces and non-faces rectangles.

Figure 2: Image NASA2 with the algorithm implemented

Question 2:

The result observed in *Figure 2* is pretty nice, nearly all faces are detected which is how the algorithm is proposed, to avoid false negatives.

The drawback of this is the detection of false positives in hands or zones in the background with higher contrast.
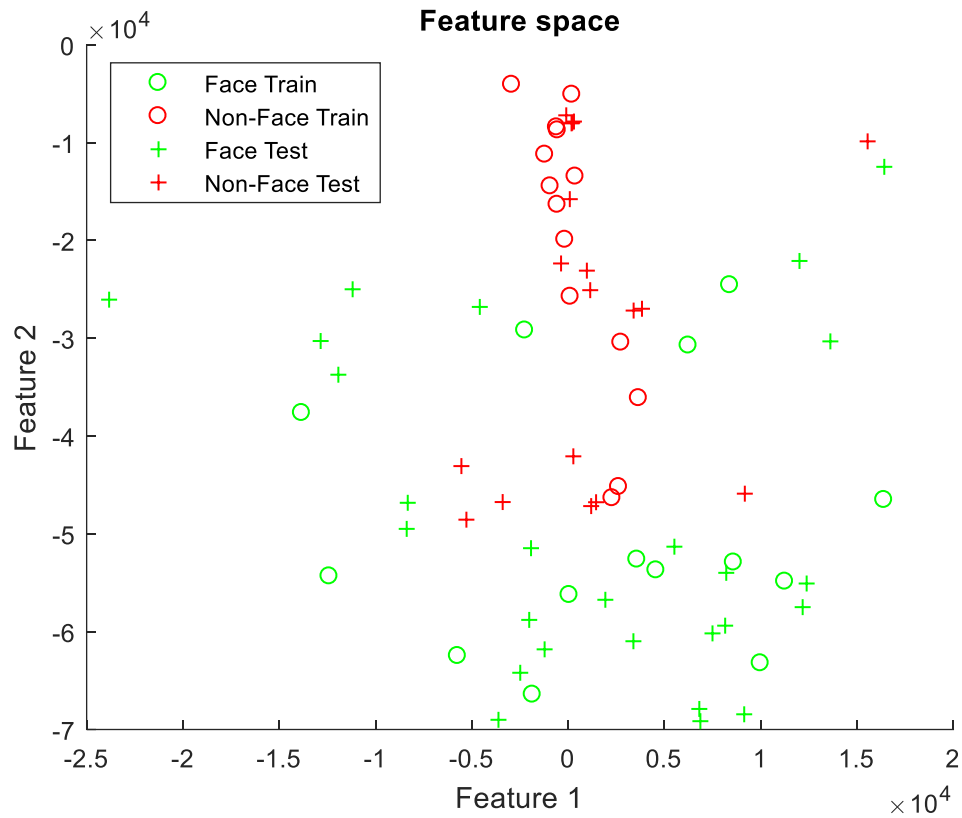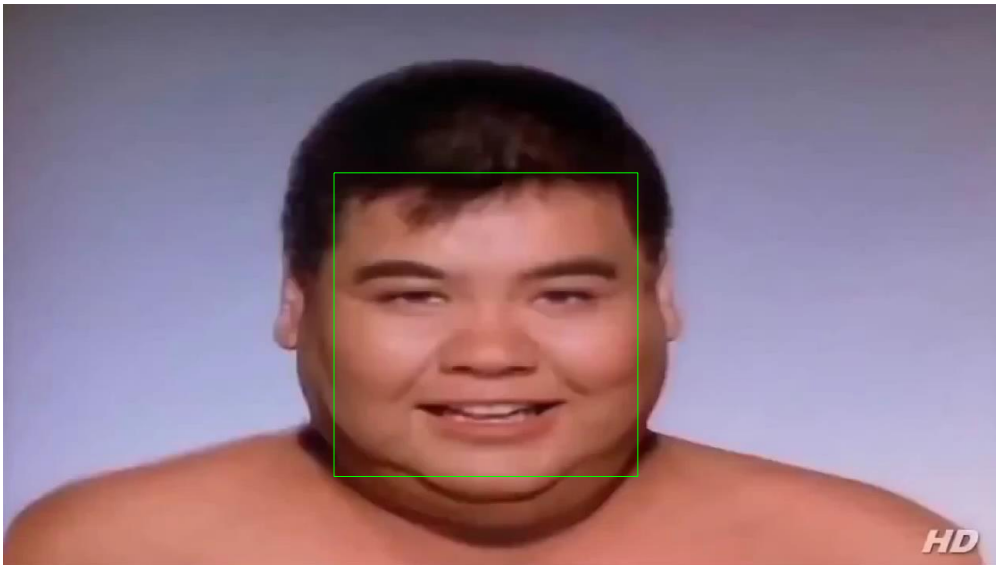
Figure 3: Feature space from image NASA2 using training and test

Question 3:

In *Figure 3* we observe that, despite the fact that we thought it would be the other way around, the Non-Face rectangles have better delimited range of values for their Haar-like features and the Face ones are more spread.

2- Viola & Jones

Figure 4: Video frame with a correct face detection

Figure 5: Video frame without a correct face detection

Question 4:

The problem we can observe in *Figure 4* and *Figure 5*, is that Viola & Jones method is only able to detect faces when they are facing the screen.

3- Gender recognition

Question 5:

ARFace.person contains the identifiers for each one of the 85 different people.

The size of internal is 1188x2210 because the internal images are 36x33 pixels (which is 1188) and there are 2210 different samples.

Figure 6: Eigen faces from our set

As we can see in *Figure 6*, the eigen faces are a kind of neutral face where you cannot identify any person but the outline main features of a face that might be able to perform the identifications.

We can also observe that the first 5 ones are far more significative than the others because the contrast is really higher.

Question 6:

- 'n' is a vector that contains Ntest different subjects ID.
- Index is a Boolean vector with size 'Number of instances' that is true for the instances whose subject is one of the subjects contained in 'n'.

Question 7:

- Sensitivity: Proportion of positives correctly identified.

- Specificity: Proportion of negatives correctly identified.

- Precision: From all classified as positives, the proportion that are real positives.

- FAR: Division between negatives classified as positives and the real positives.

- Recall: Same as Sensitivity

- Accuracy: From all samples, the proportion that were correctly classified.

- Error: Average of the error in each iteration (which is 1-accuracy)

- Confusion matrix: Matrix that represent the amount of times that a sample of class X is classified as class X,Y,Z,…

	PCA	PCA95	LDA
Sensitivity	82.5275	55.0905	99.7863
Specificity	81.9658	82.4415	99.7378
Precision	78.0665	69.8709	99.6798
FAR	23.1868	23.7557	0.3205
Recall	82.5275	55.0905	99.7863
Accuracy	82.2115	70.8173	99.7596
Error	21.1764	21.1909	0.3010

Table 1: Obtained results

As we can observe in *Table 1*, the best method, as expected, is the LDA. This is due to the fact that the feature extraction with it is computed taking into account the ground truth, which makes the classification far more precise.

When it comes to the difference in performance between PCA and PCA95 we need to understand first the difference in the methods:

- PCA: Performs a reduction to a fixed number of dimensions, 5 in this case.

- PCA95: Performs a reduction to a number of dimensions that maintains 95% of the variance, 124 in this case.

PCA95 performs worse because it maintains to much irrelevant information for the model and this produces overfitting, so, when the model is used with a test set the sensitivity, specificity and accuracy are clearly worse.

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4- Subject recognition

Question 8:

We have to distribute the samples for the cross-validation strategy so that in each iteration there is at least 1 instance of every different subject in the training set and in the test set, and try to maintain the proportion of instances from each of the subject in each of the sets.