

**ECE 763**  
**Project 1**

**Face Image Classification**



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## Objective

Binary face image classification  $\omega \in \{0,1\}$  using Gaussian model, Mixture of Gaussian model, t-distribution, and Factor Analysis. For each classification model the results are reported as follows:

- Visualizing the mean and covariance matrices for face and non-face images.
- Evaluation of the learned model on the testing images using 0.5 as threshold for the posterior by computing the false positive rate, false negative rate and the misclassification rate.
- Plot of the Receiver Operating Characteristic Curve (ROC Curve)

## Data Preparation

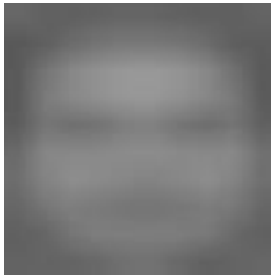
- I have used the FDDB dataset (<http://vis-www.cs.umass.edu/fddb/>), which contains the annotations for 5171 faces in a set of 2845 images taken from the Faces in the Wild data set.
- The data set comes with a annotations folder which contains files with names: FDDB-fold-xx.txt and FDDB-fold-xx-ellipseList.txt, where  $xx = \{01, 02, \dots, 10\}$  represents the fold-index. Each line in the "FDDB-fold-xx.txt" file specifies a path to an image in the above-mentioned data set. The corresponding annotations are included in the file "FDDB-fold-xx-ellipseList.txt".
- Here, each face is denoted by:  $\langle \text{major\_axis\_radius} \text{ minor\_axis\_radius} \text{ angle} \text{ center\_x} \text{ center\_y} \text{ 1} \rangle$ .
- I extracted the face images from the coordinates of the rectangles created from the ellipses and resized to 20 x 20.
- I extracted the non-face images by checking the boundaries of the face rectangle coordinates for each image, and considering the intersection over union criteria.
- In this way, I created 1000 training images for face and non-face each and 100 testing images for face and non-face.

## Model 1 : Single Gaussian

### Results

True Positives: 85  
False Negatives: 15  
True Negatives: 63  
False Positives: 37  
**Accuracy: 0.74**  
Misclassification Rate: 0.26

### Face:



Mean



Covariance

### Non-Face:

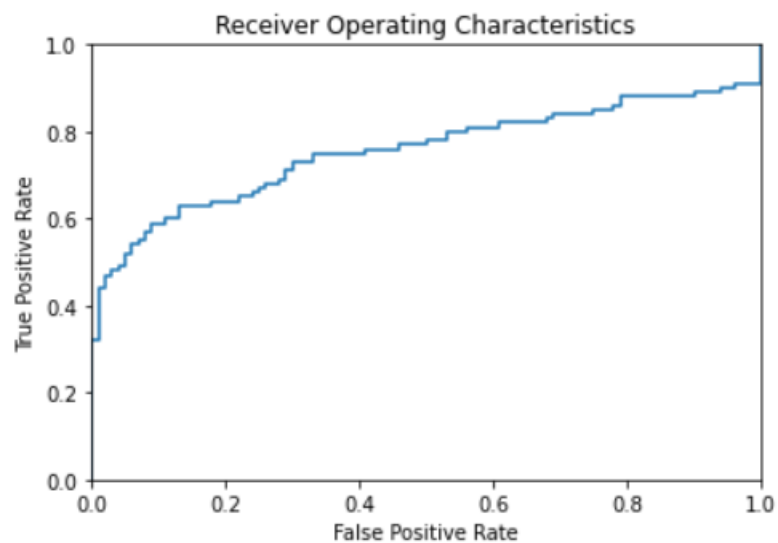


Mean



Covariance

### ROC:



## Model 2 : Mixture of Gaussian

### Results K = 3

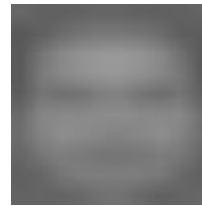
True Positives: 85  
False Negatives: 15  
True Negatives: 63  
False Positives: 37

**Accuracy: 0.74**

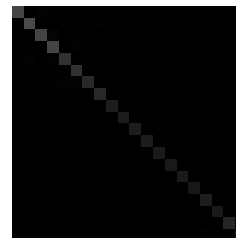
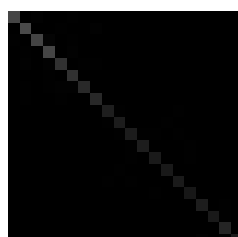
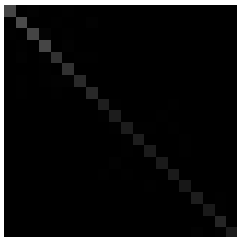
Misclassification Rate: 0.26

### Face:

#### Means



#### Covariances (Diagonal)

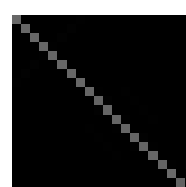
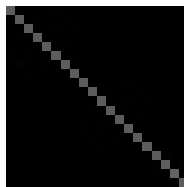
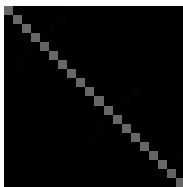


## Non-Face:

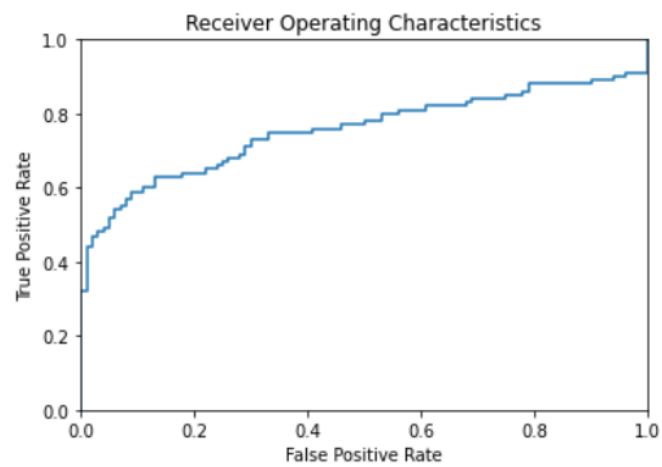
Means



Covariances (Diagonal)



## ROC:

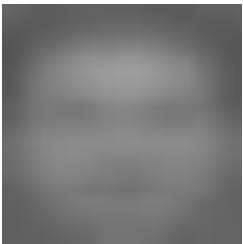


# Model 3 : T - Distribution

## Results

True Positives: 94  
False Negatives: 6  
True Negatives: 43  
False Positives: 57  
**Accuracy: 0.685**  
Misclassification Rate: 0.315

## Face:

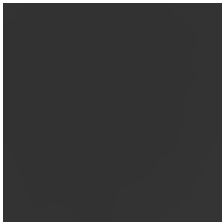


Mean



Covariance

## Non-Face:

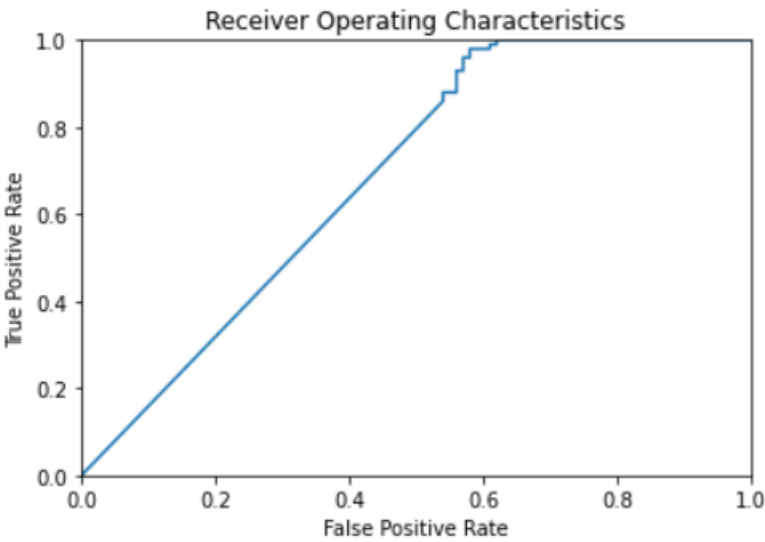


Mean



Covariance

## ROC:

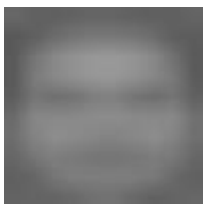


# Model 4 : Factor Analyzer

## Results

True Positives: 100  
False Negatives: 0  
True Negatives: 86  
False Positives: 14  
**Accuracy: 0.93**  
Misclassification Rate: 0.07

## Face:



Mean



Covariance

## Non-Face:



Mean



Covariance

## ROC:

