ECE 763 – Computer Vision

Project 01

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Data Preparation:

The dataset used for this project is FDDB. The following are some assumptions or modifications made for this project:

- I have assumed that each pixel is independent of every other pixel for all the models and hence the co-variance matrix in each model only has diagonal elements, i.e. the diagonal co-variance matrix is considered.
- In order to reduce number of computations and avoid the overflow error, I have considered the images in gray scale.

Steps:

- An image in the training dataset is of size 60x60 with 3 color channels (RGB).
- This image is converted to one with a single-color channel to make it a gray scale image.
- The pixels are then arranged row-wise to form a column vector of dimensions 3600x1.
- The 1000 images in the training dataset are appended together to the above vector to form a matrix of size 3600x1000.
- I've applied Principal Component Analysis (PCA) to this matrix in order to reduce the number of features to 100, thereby forming a matrix of size 100x1000.
- Each column of this matrix is now a data sample.

Results:

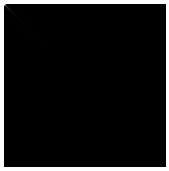
1. Single Gaussian Model:

Mean of Face data

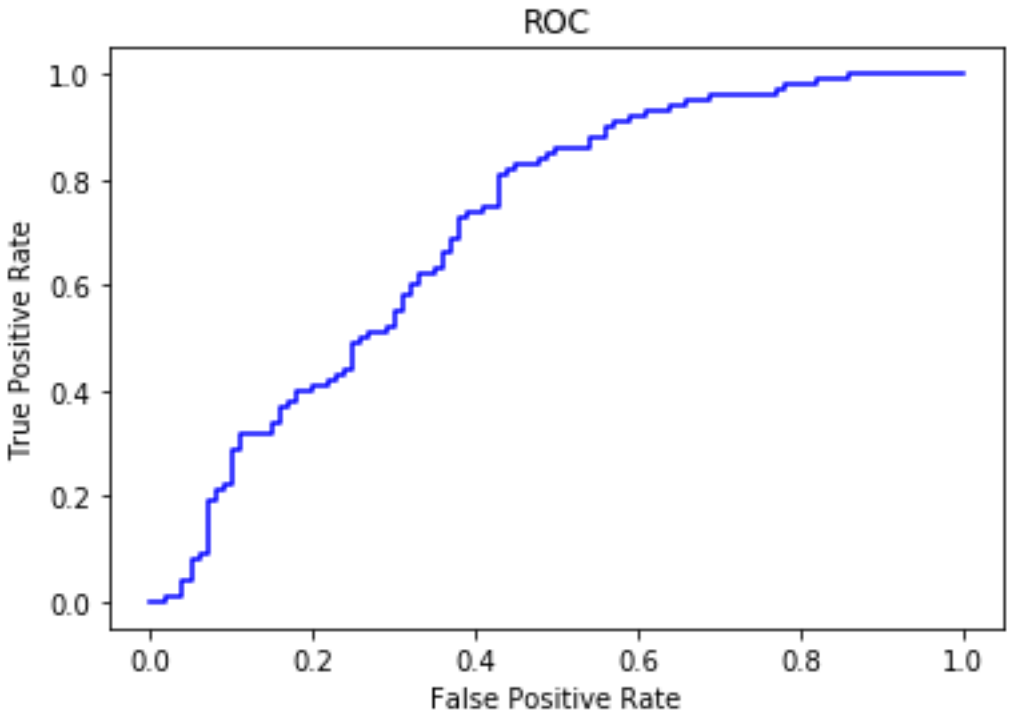
Mean of Non-Face data

Co-variance Face

Co-variance Non-Face



The co-variance matrix is a diagonal matrix. Hence the image appears black where only diagonal elements have non-zero values.



Threshold = 0.584

False Negative Rate = 0.36
True Positive Rate = 0.64
False Positive Rate = 0.36

Misclassification Rate = 0.36

2. Mixture of Gaussian Model:

Number of Gaussian Components = 3

Mean of Face data

Component-0

Component-1

Component-2

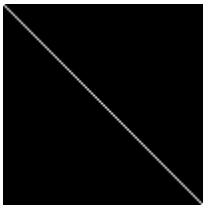
Mean of Non-Face data

Component-0

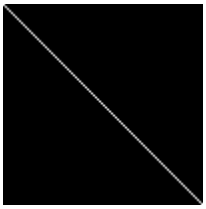
Component-1

Component-2

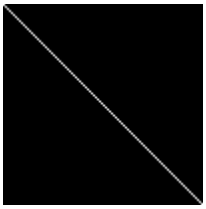
Co-variance of Face Data



Component-0

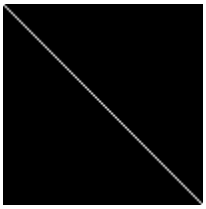


Component-1

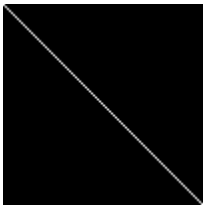


Component-2

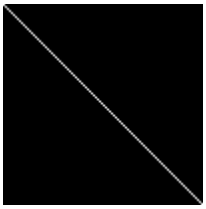
Co-variance of Non-Face data



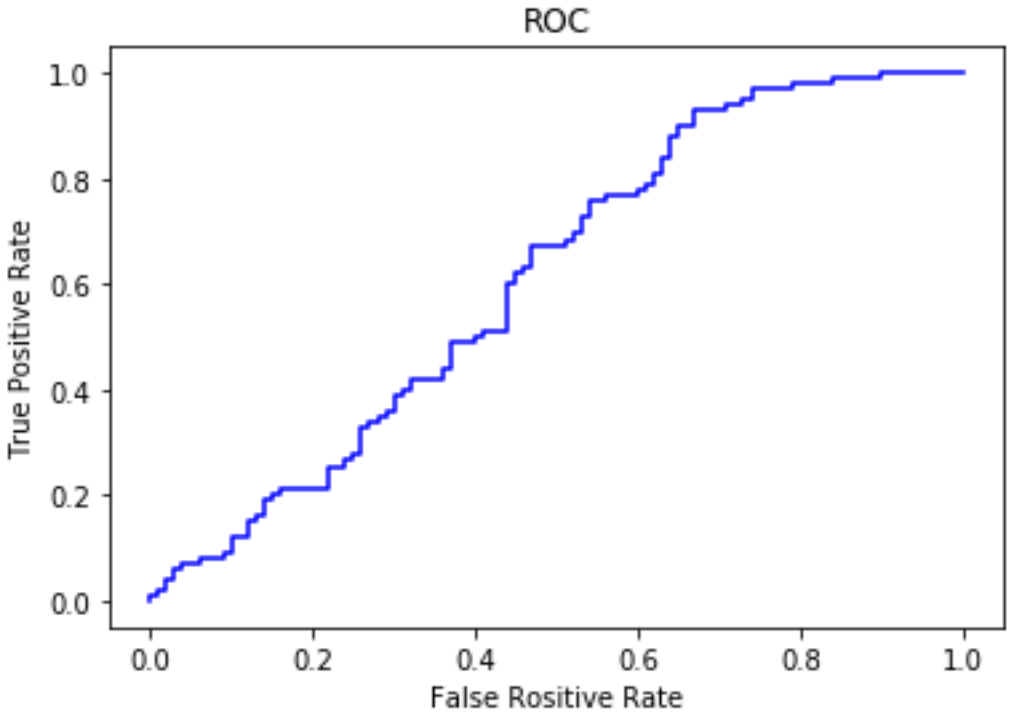
Component-0



Component-1



Component-2



Threshold = 0.519

False Negative Rate = 0.43
True Positive Rate = 0.57
False Positive Rate = 0.43

Misclassification Rate = 0.43

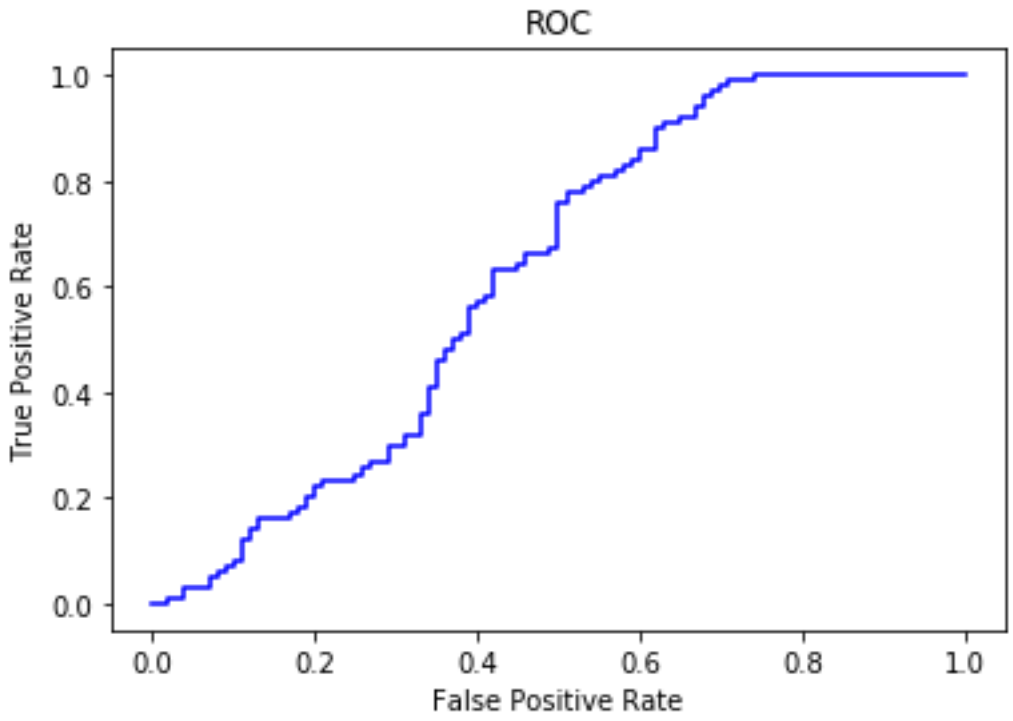
3. t-Distribution Model:

Mean of Face data

Mean of Non-Face data

Co-variance Face

Co-variance Non-Face



Threshold = 0.477

False Negative Rate = 0.17
True Positive Rate = 0.83

False Positive Rate = 0.57

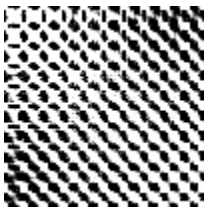
Misclassification Rate = 0.37

4. Factor Analyzer:
   Number of Factors = 5

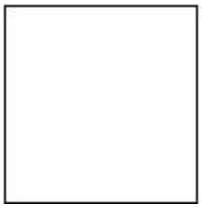
Mean of Face data

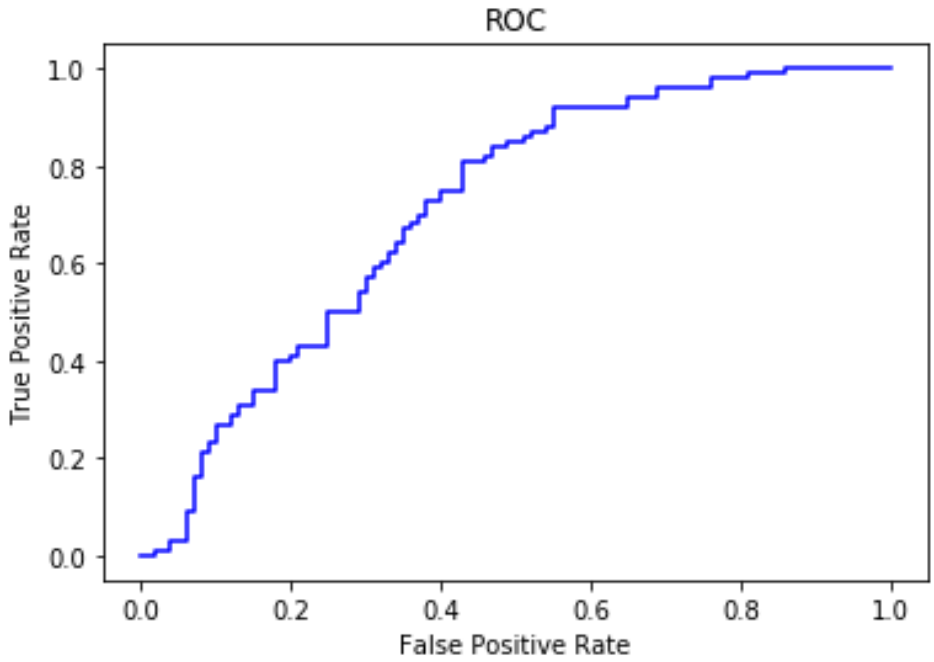
Mean of Non-Face data

Co-variance Face



Co-variance Non-Face





Threshold = 0.518

False Negative Rate = 0.21
True Positive Rate = 0.79
False Positive Rate = 0.46

Misclassification Rate = 0.33

5. Mixture of t-Distribution:

Number of components = 3

Mean of Face data


Component-0


Component-1


Component-2

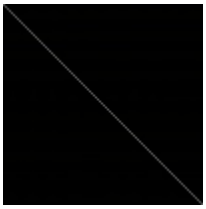
Mean of Non-Face data

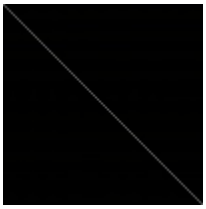

Component-0

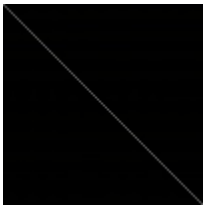

Component-1


Component-2

Co-variance of Face Data


Component-0


Component-1

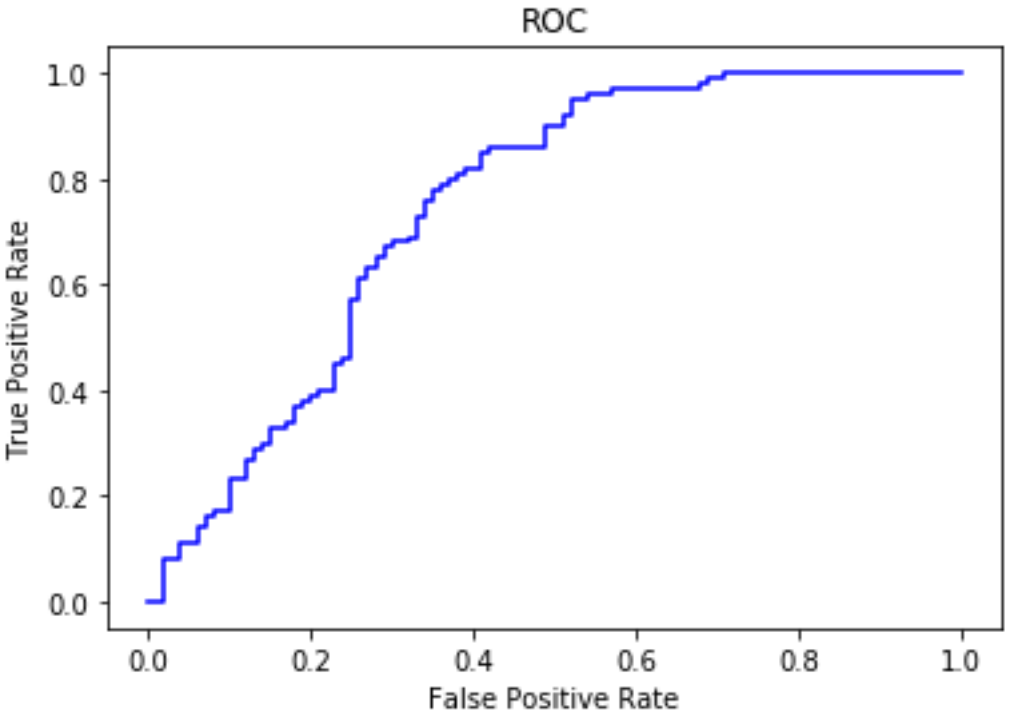

Component-2

Co-variance of Non-Face data

Component-0

Component-1

Component-2



Threshold = 0.5

False Negative Rate = 0.22
True Positive Rate = 0.78
False Positive Rate = 0.3

Misclassification Rate = 0.26