

**TITLE: PROJECT 1**

SUBJECT: ECE 763 (COMPUTER VISION)



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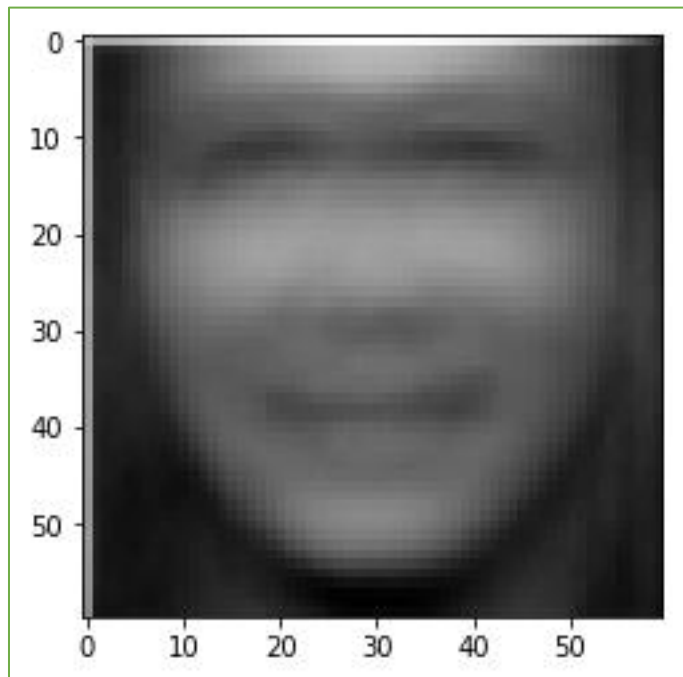
## STEP 1: DATA PREPROCESSING:

1. For the project, I used the UMD face dataset (Batch 3) available at the following [link](#).
2. After downloading the dataset, the first code that I wrote was a Data Preprocessing and Input/output module code in Python.
3. The data preprocessing python code read the annotations from the annotation file and extracted the face from an image and for the background, I randomly cropped a portion of the background image.  
Note: I saved the image in dimensions of 60 X 60
4. After doing the data preprocessing, I divided the data into 4 folders.  
Train\_FaceData, Train\_NonFaceData, Test\_FaceData & Test\_NonFaceData.
5. The data preprocessing python code is attached in the zipped folder.

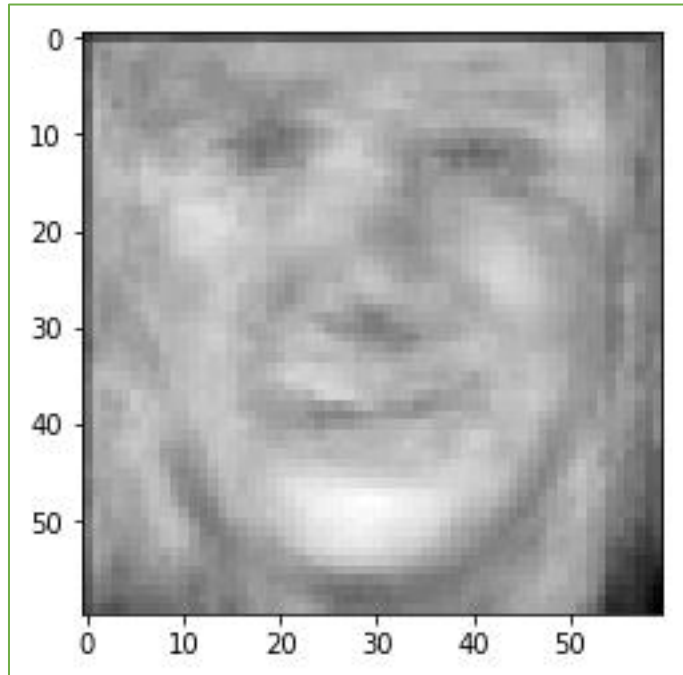
## STEP 2: LEARNING A SINGLE GAUSSIAN MODEL:

1. In this model, I wrote a code to learn a single Gaussian model from the training data and performed the following tasks.

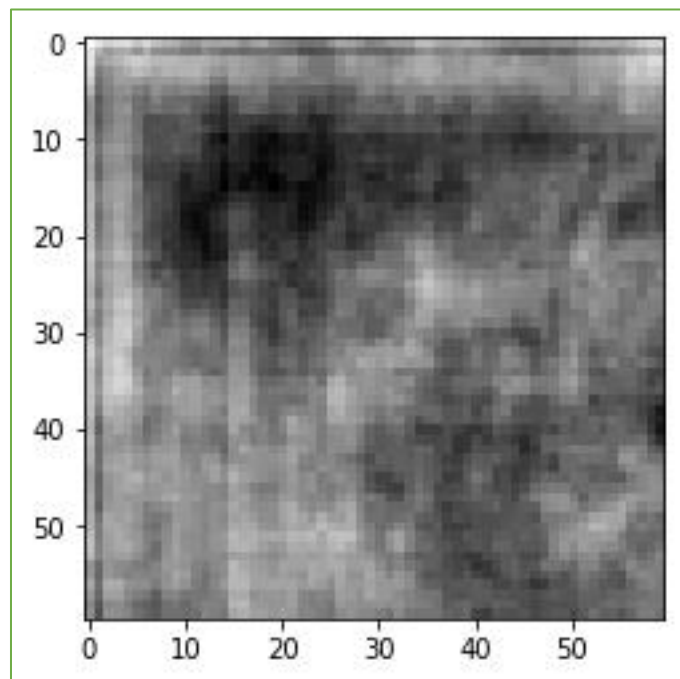
### 1.1 Visualize estimated mean from face data:



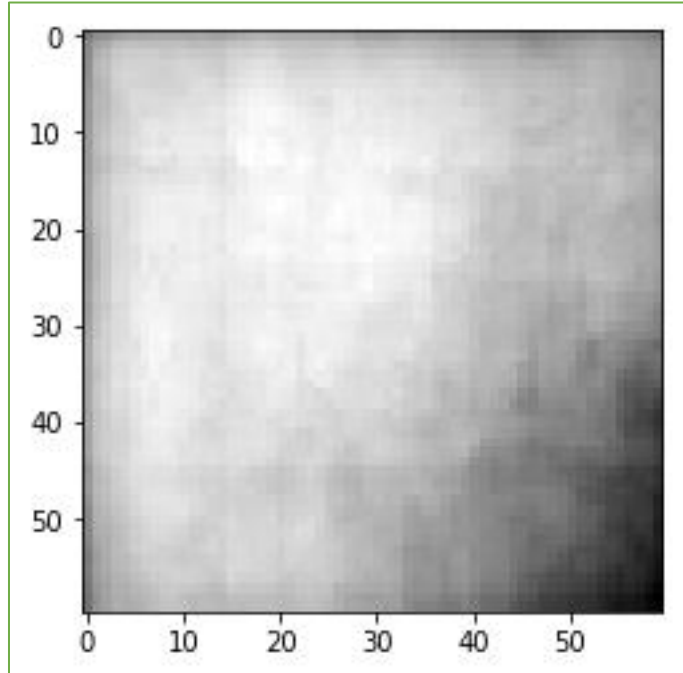
1.2 Visualize estimated covariance form face data:



1.3 Visualize estimated mean form non face data:



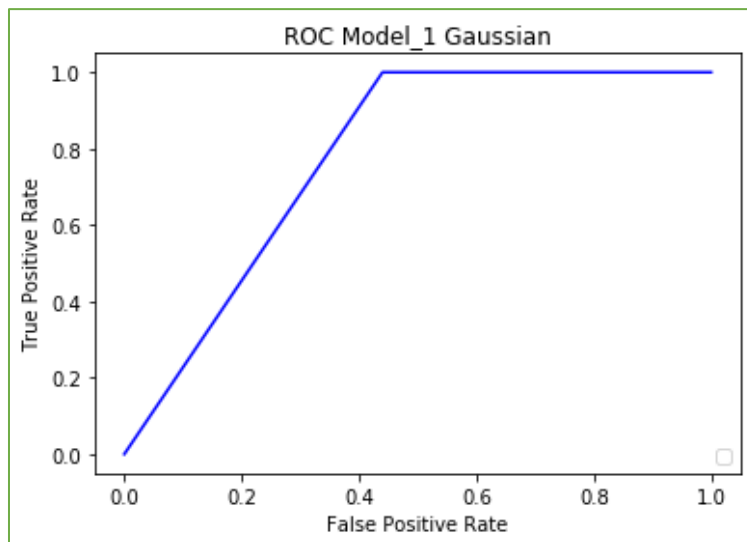
#### 1.4 Visualize estimated covariance form non face data:



#### 1.5 Calculation of Performance Rates by setting threshold=0.5:

FALSE POSITIVE RATE	0.325
FALSE NEGATIVE RATE	0.167
MISCLASSIFICATION RATE	0.392

#### 1.6 Plotting of the ROC:

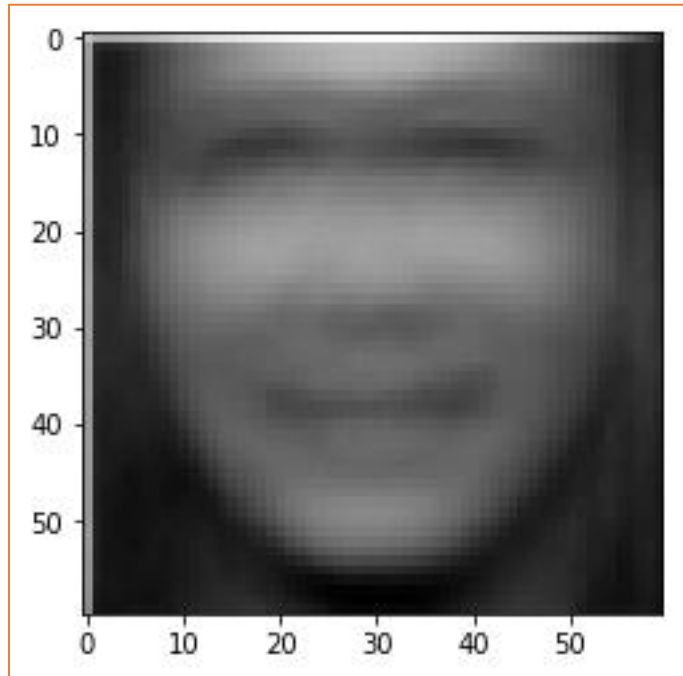


Note: The Single Gaussian Python code is attached in the zipped folder.

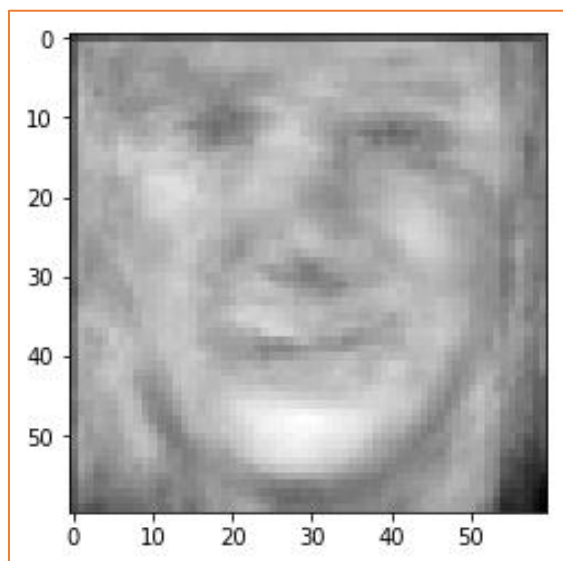
## STEP 2: LEARNING A MIXTURE OF GAUSSIAN MODEL:

2. In this model, I wrote a code to learn a single Mixture of Gaussian ( $K=3$ ) model from the training data and performed the following tasks.

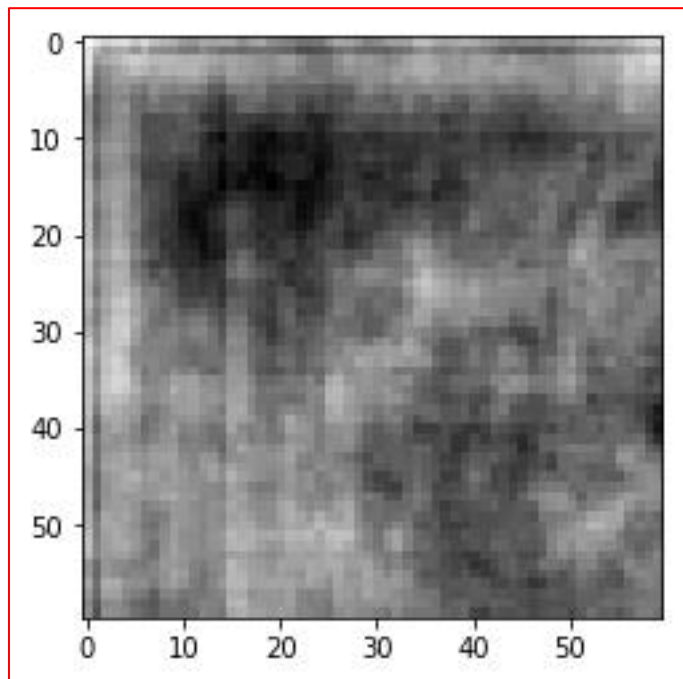
2.1 Visualize estimated mean form face data:



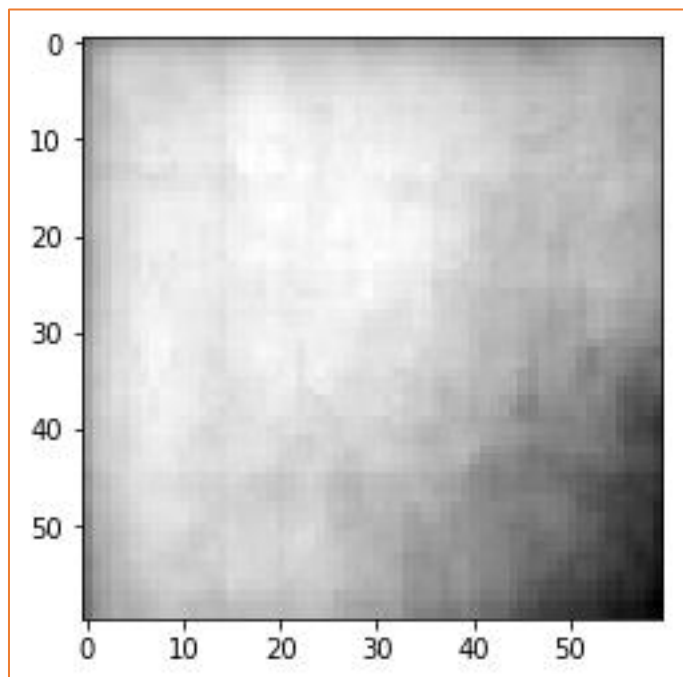
2.2 Visualize estimated covariance form face data:



2.3 Visualize estimated mean form non face data:



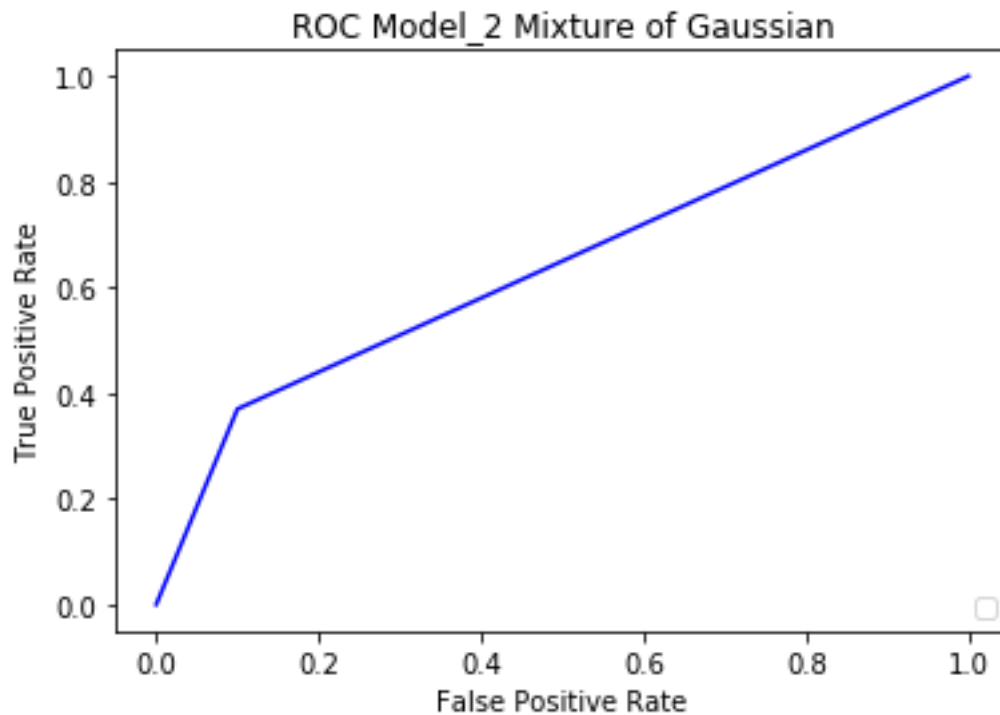
2.4 Visualize estimated covariance form non face data:



2.5 Calculation of Performance Rates by setting threshold=0.5:

FALSE POSITIVE RATE	0.237
FALSE NEGATIVE RATE	0.132
MISCLASSIFICATION RATE	0.265

2.6 Plotting of the ROC:

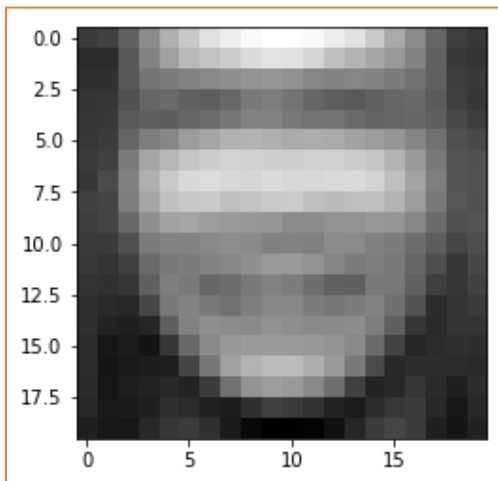


Note: The Mixture of Gaussian Python code is attached in the zipped folder. We also see that the misclassification rates decreases when we model the data using Mixture of Gaussians.

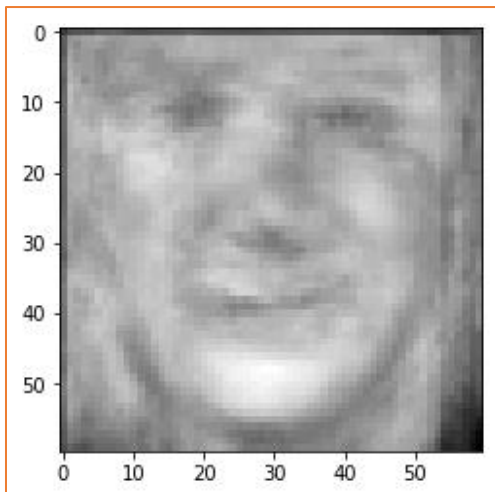
### STEP 3: LEARNING A T DISTRIBUTION MODEL:

3. In this model, I wrote a code to learn T distribution model from the training data and performed the following tasks.

#### 3.1 Visualize estimated mean form face data:

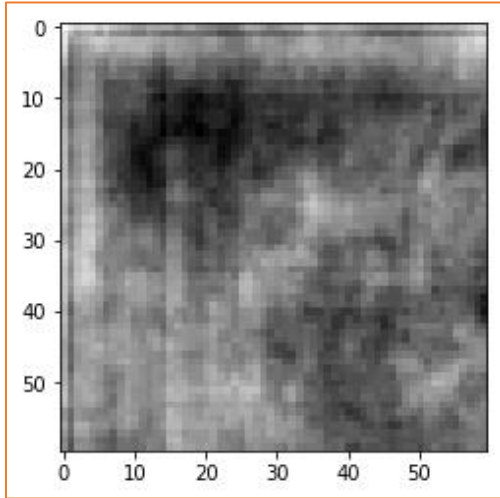


#### 3.2 Visualize estimated covariance form face data:

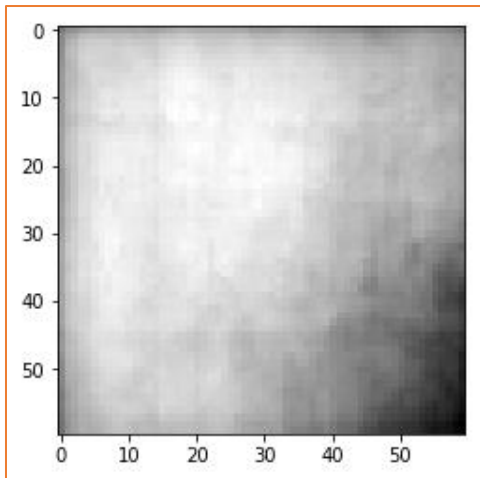




### 3.3 Visualize estimated mean form non face data:



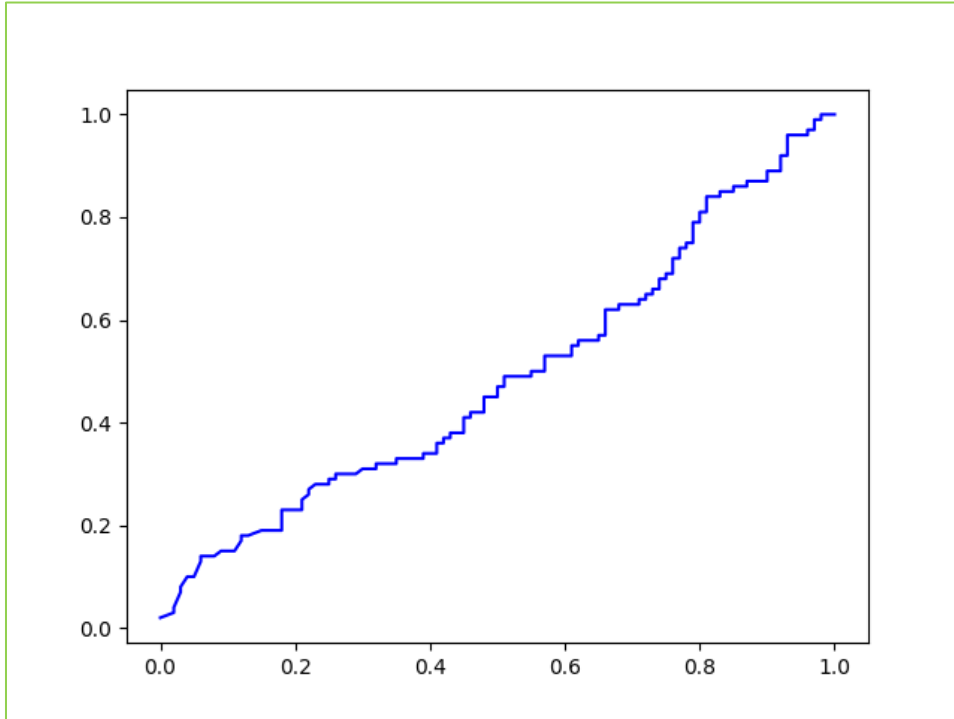
### 3.4 Visualize estimated covariance form non face data:



### 3.5 Calculation of Performance Rates by setting threshold=0.5:

FALSE POSITIVE RATE	0.318
FALSE NEGATIVE RATE	0.152
MISCLASSIFICATION RATE	0.336

### 3.6 Plotting of the ROC:

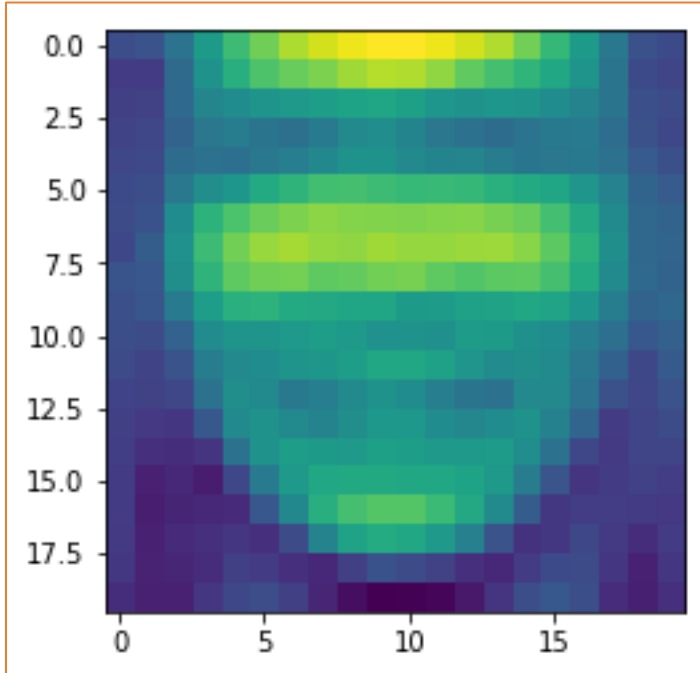


Note: The T Distribution Python code is attached in the zipped folder

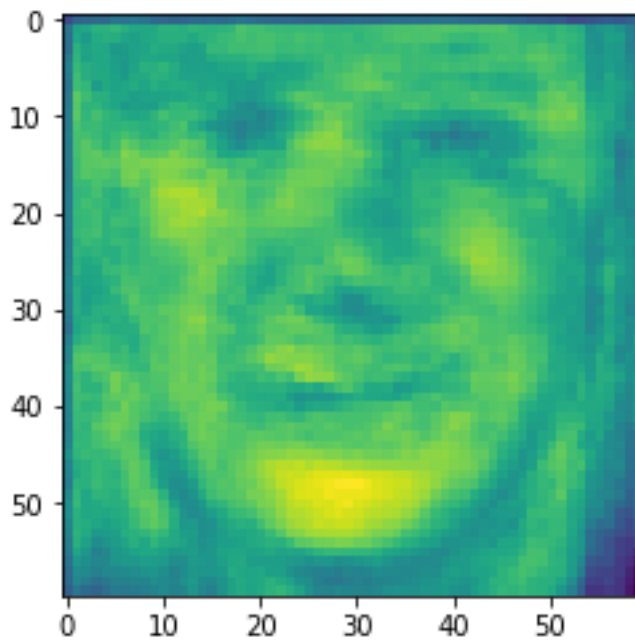
#### **STEP 4: LEARNING A MIXTURE OF T DISTRIBUTION MODEL:**

4. In this model, I wrote a code to learn a mixture of T distribution model from the training data and performed the following tasks.

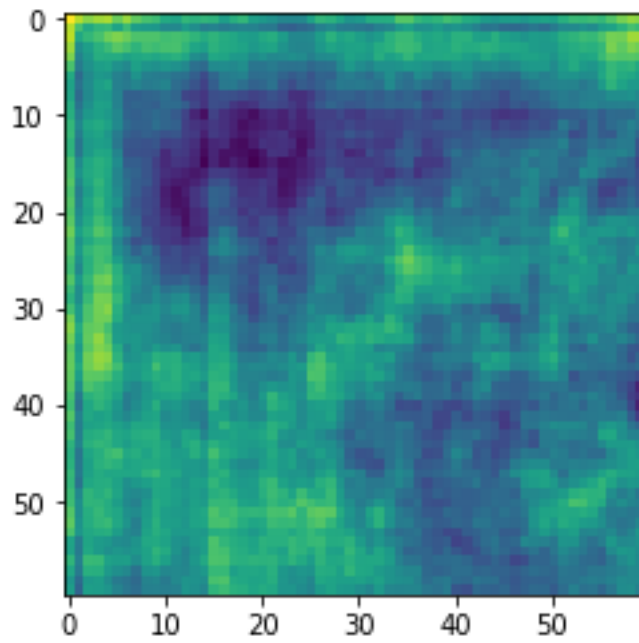
#### 4.1 Visualize estimated mean form face data:



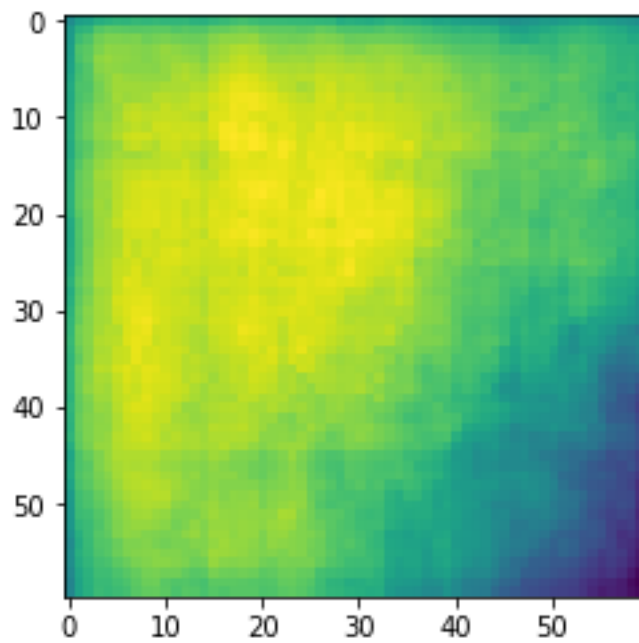
#### 4.2 Visualize estimated covariance form face data:



4.3 Visualize estimated mean form non face data:



4.4 Visualize estimated mean form non face data:



#### 4.5 Calculation of Performance Rates by setting threshold=0.5:

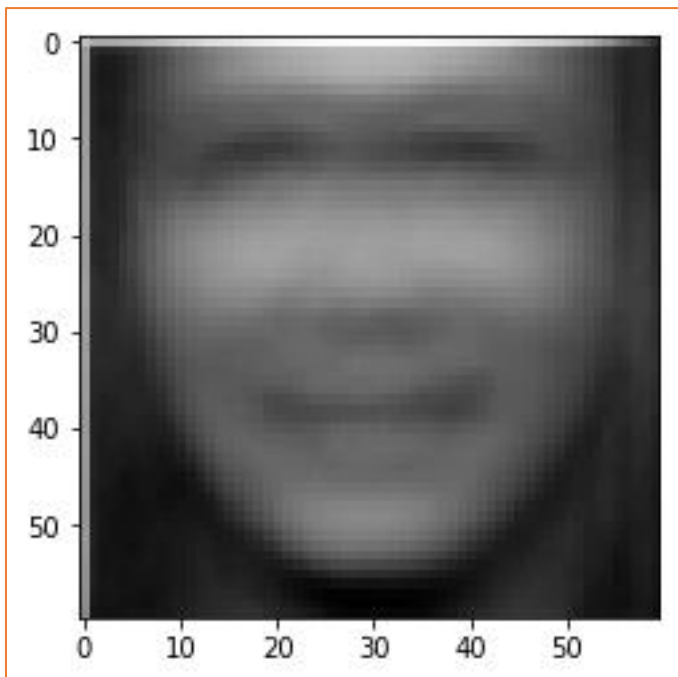
FALSE POSITIVE RATE	0.248
FALSE NEGATIVE RATE	0.112
MISCLASSIFICATION RATE	0.236

Note: The Mixture of T code is attached in the zipped folder. We also see that the misclassification rates decreases when we model the data using Mixture of T distribution.

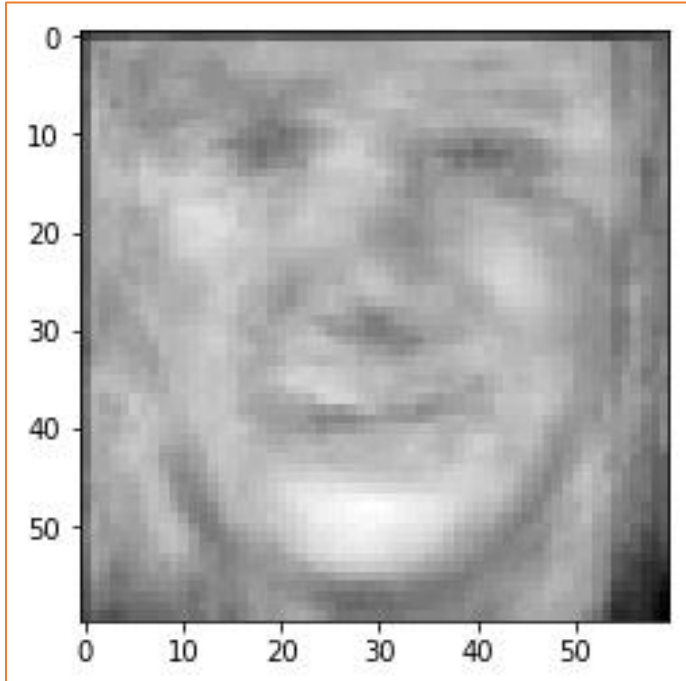
#### STEP 5: LEARNING A FACTOR ANALYZER MODEL:

5. In this model, I wrote a code to learn a Factor Analyzer model from the training data and performed the following tasks.

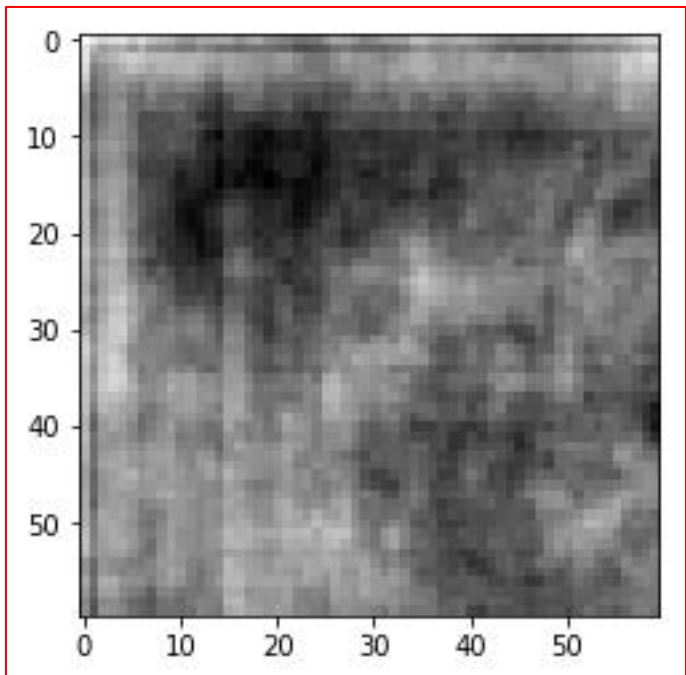
##### 5.1 Visualize estimated mean form face data:



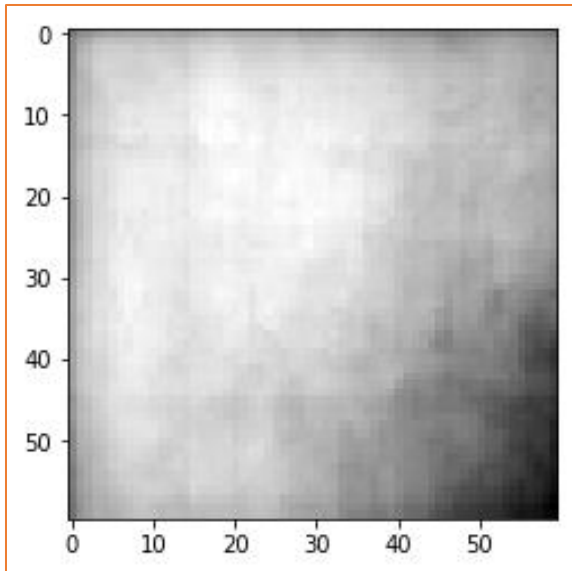
5.2 Visualize estimated covariance form face data:



5.3 Visualize estimated mean form non face data:



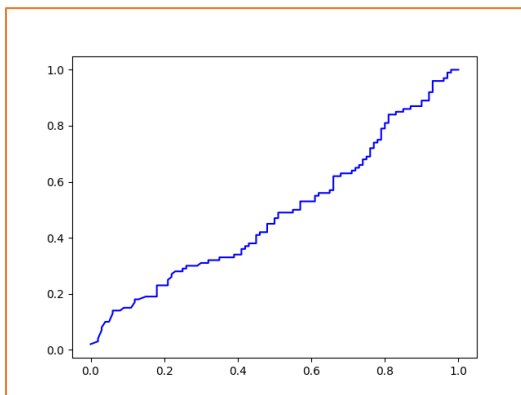
5.4 Visualize estimated mean form non face data:



5.5 Calculation of Performance Rates by setting threshold=0.5:

FALSE POSITIVE RATE	0.288
FALSE NEGATIVE RATE	0.142
MISCLASSIFICATION RATE	0.313

5.6 Plotting of the ROC:



Note: The Factor Analyzer python code is attached in the zipped folder.