Single Gaussian vs. Mixture-of-Gaussians Models for Pattern Recognition

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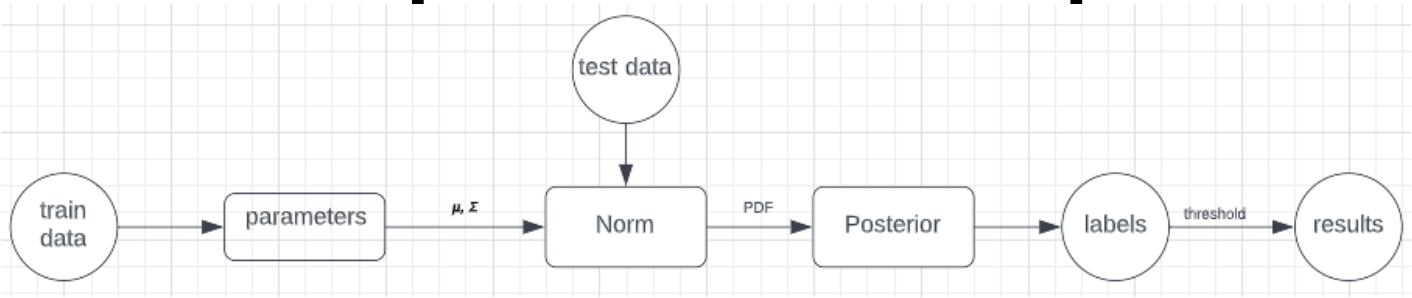
Introduction

- Implementing a single-Gaussian and/to a Gaussian-mixture model to classify face and non-face images in the FDDB dataset
- Comparing the two models' performance
- [1] describes the format of the FDDB dataset
- [4] shows typical algorithm to extract annotated object(s) in images
- [2] explains the Gaussian-mixture model and its foundational components needed to successfully build a better and accurate model
- [3] explains mathematical foundations of single-Gaussian, Gaussian-mixture, and other probabilistic distribution-based classifiers

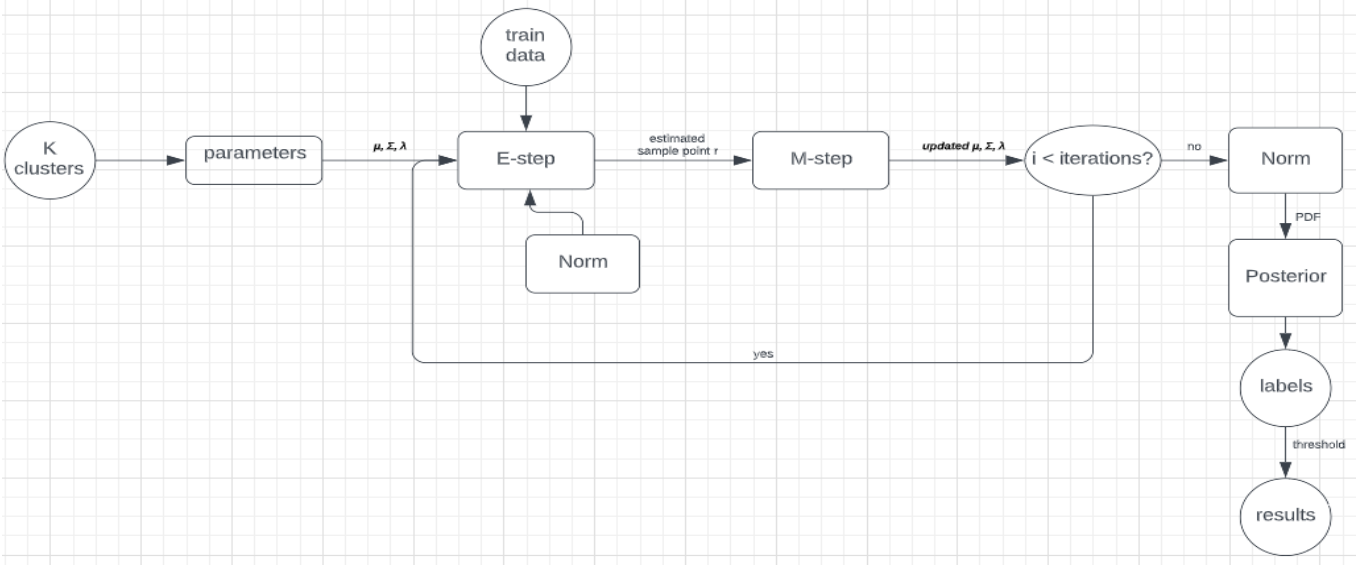
Experimental set-up

- Trained two models on 10x10 grayscale images from the FDDB dataset, pixels (intensities) themselves were features
- Compared their performance (such as misclassification rate, false-positive rate, false-negative rate, ROC)
- Original FDDB dataset: annotations for 5171 faces in a set of 2845 images
  - 1000 images each of face and non-face images for training set and 100 images each of face and non-face for test set to ensure the best image quality were carefully and manually picked
  - No images in the training set appeared in the test set.
  - Total of ~2,200 images used

Experimental set-up



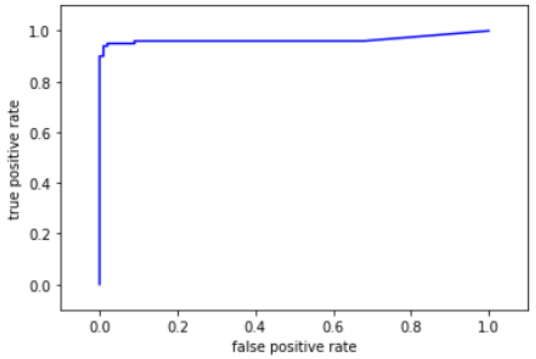
SG Algorithm Flowchart



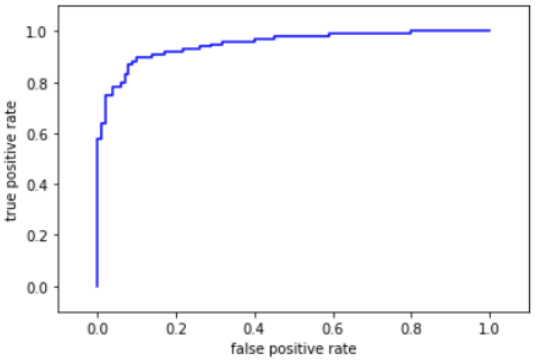
MoG Algorithm Flowchart

Results

- SG's TP rate was only 3% while it assumed pretty much all images as non-face (88%) and misclass. rate was high (37%)
- MoG's TN rate went down to 68% => generalized better for face images (32% in TP rate) due to multiple Gaussian distributions that could handle outliers
- MoG's misclass. rate was low (17%)



SG ROC



MoG ROC

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True-Positive Rate	0.03	0.32
True-Negative Rate	0.88	0.68
False-Positive Rate	0.56	0.13
False-Negative Rate	0.18	0.21
Misclassification Rate	0.37	0.17

Model Performance Comparison

Conclusion

- Summary
  - MoG model performed better than SG model on the 10x10 grayscale images in the FDDB dataset for face and non-face.
- Key insights
  - MoG model had the lower misclassification rate and seemed to generalize and handle outliers better
  - Combinations of 4, 9, and 0.55 of the number of clusters, number of iterations, and threshold values relatively gave the lowest misclassification rate for the two modelsand handle outliers better
  - Will experiment the two models on larger images such as 20x20 or 60x60 RGB