CLUSTERING IMAGES WITH UNSUPERVISED LEARNING

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OBJECTIVE

We consider a dataset consisting of images of shoes, sandals, and boots. The objective of this small project is to apply a couple of unsupervised clustering models, together with dimensionality reduction of the dataset, to classify the images.

Due to the simplicity of the approach it is not expected that the models reach high accuracy, precision and/or recall.

To analyze the outcomes of the models considered, the data has been labeled in the preprocessing part of the notebook. However only unsupervised models have been used in this work.

ABOUT THE DATASET

This Shoe vs Sandal vs Boot Image Dataset contains 15,000 images of shoes, sandals and boots. 5000 images for each category. The images have a resolution of 136x102 pixels in RGB color model. There are three classes here. Shoe, Sandal, Boot

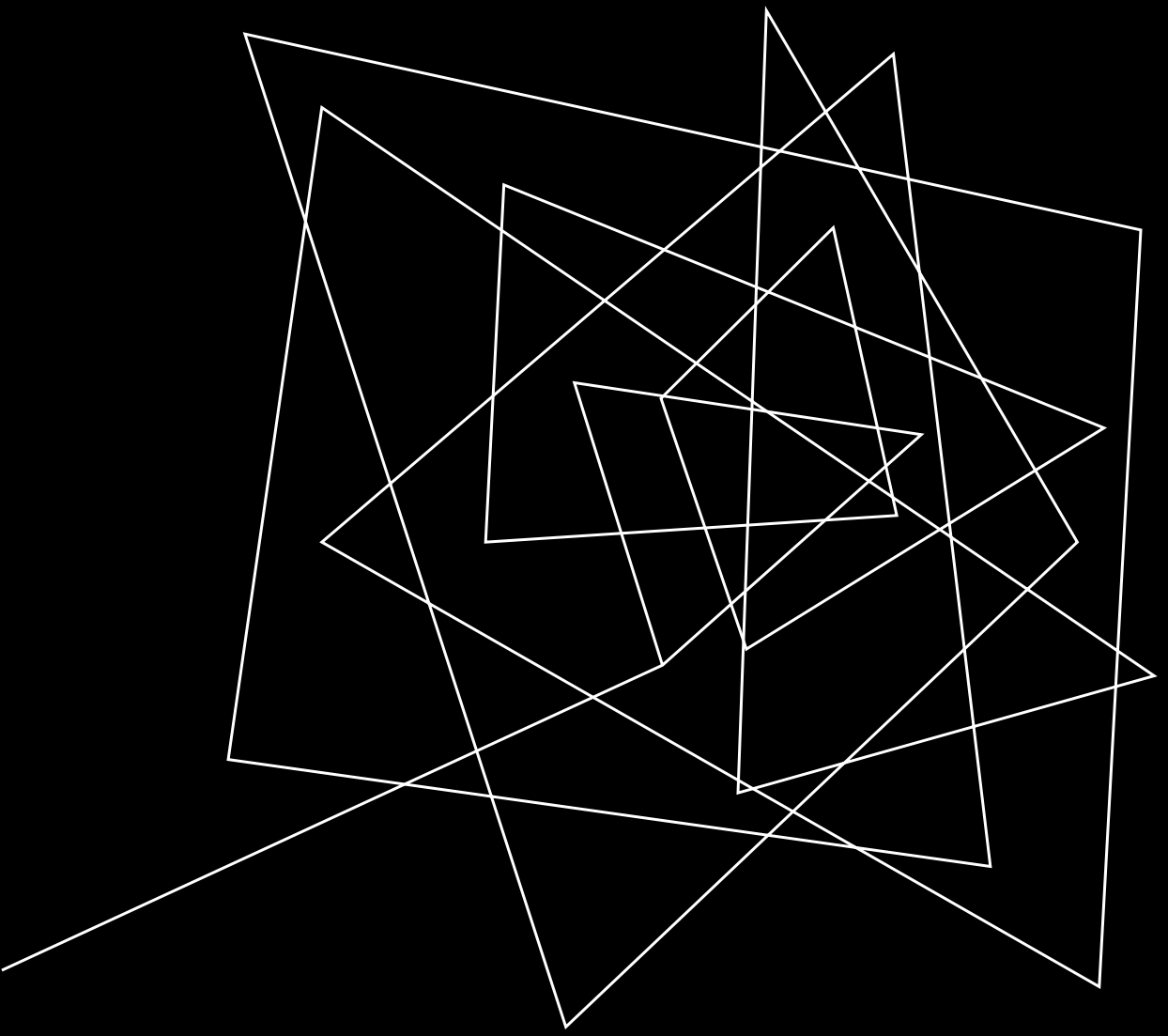
This dataset is a modified version of a large image dataset provided by M.Stephenson.

The data can be found at the following link: https://www.kaggle.com/datasets/hasibalmuzdadid/shoe-vs-sandal-vs-boot-dataset-15k-images

DATA PREPROCESSING

- **Due to the lack of RAM memory it was used only a sample of the whole data: 9000 out of the 15000 images available were used.**
- **The resolution of the images was reduced to 90x80 pixels.**
- **Each image was converted to a one dimensional array of size 90x80 = 7200.**
- **The RGB format was changed to grayscale.**
- **The images were labeled, as part of the preprocessing, in order to assess accuracy, precision, recall, and fscore.**

Sample of images on each class after reducing to resolution and converting to grayscale.



UNSUPERVISED MODELS

DIMENSIONALITY REDUCTION AND CLUSTERING

- **Principal Component Analysis (PCA).**

  PCA was applied to reduce dimensionality of the data

- **K Means Clustering**

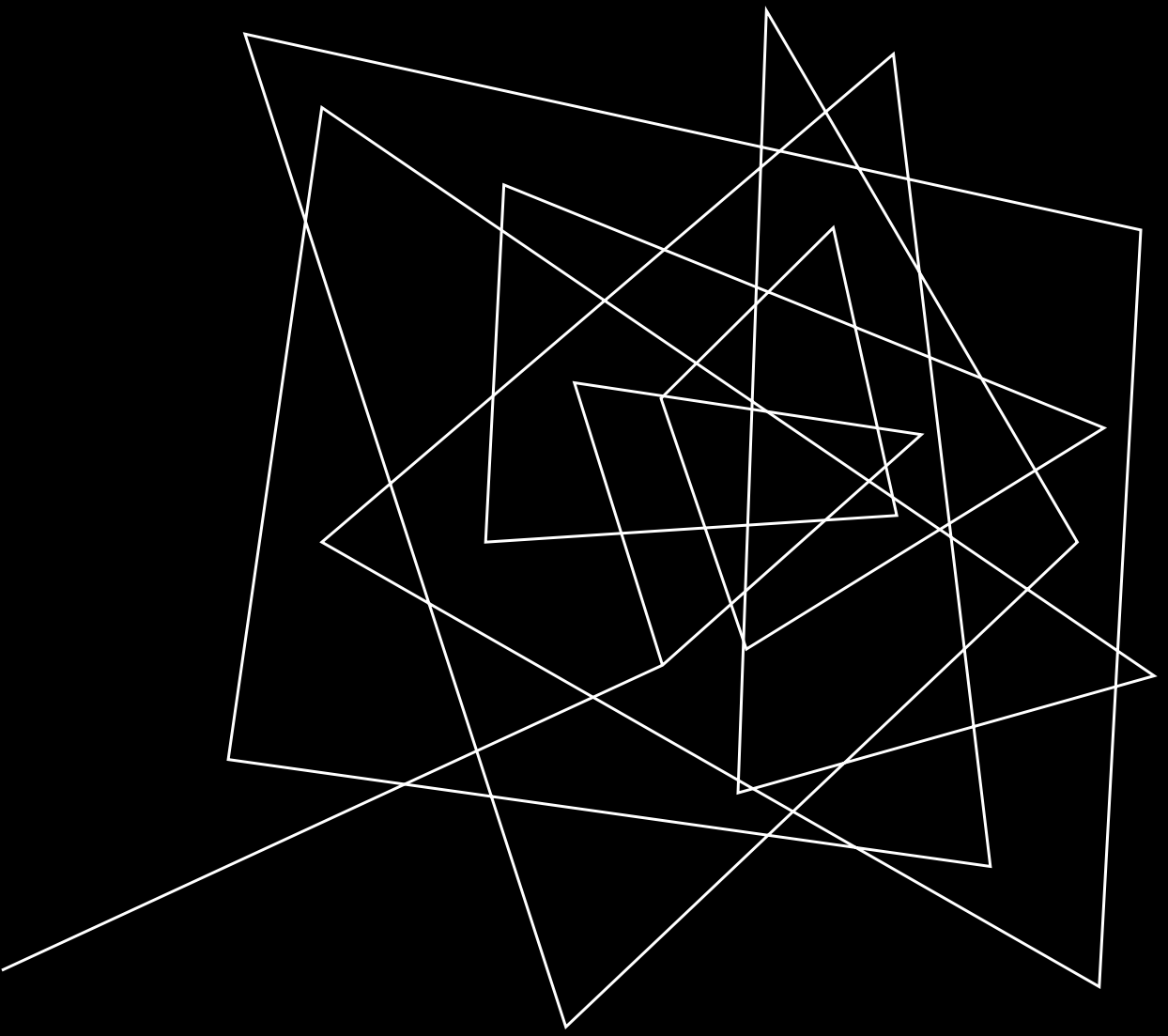
  K Means was applied to the data after reducing dimensionality with PCA.

- **Gaussian Mixture**

  Gaussian Mixture clustering was applied to the data after reducing dimensionality with PCA.

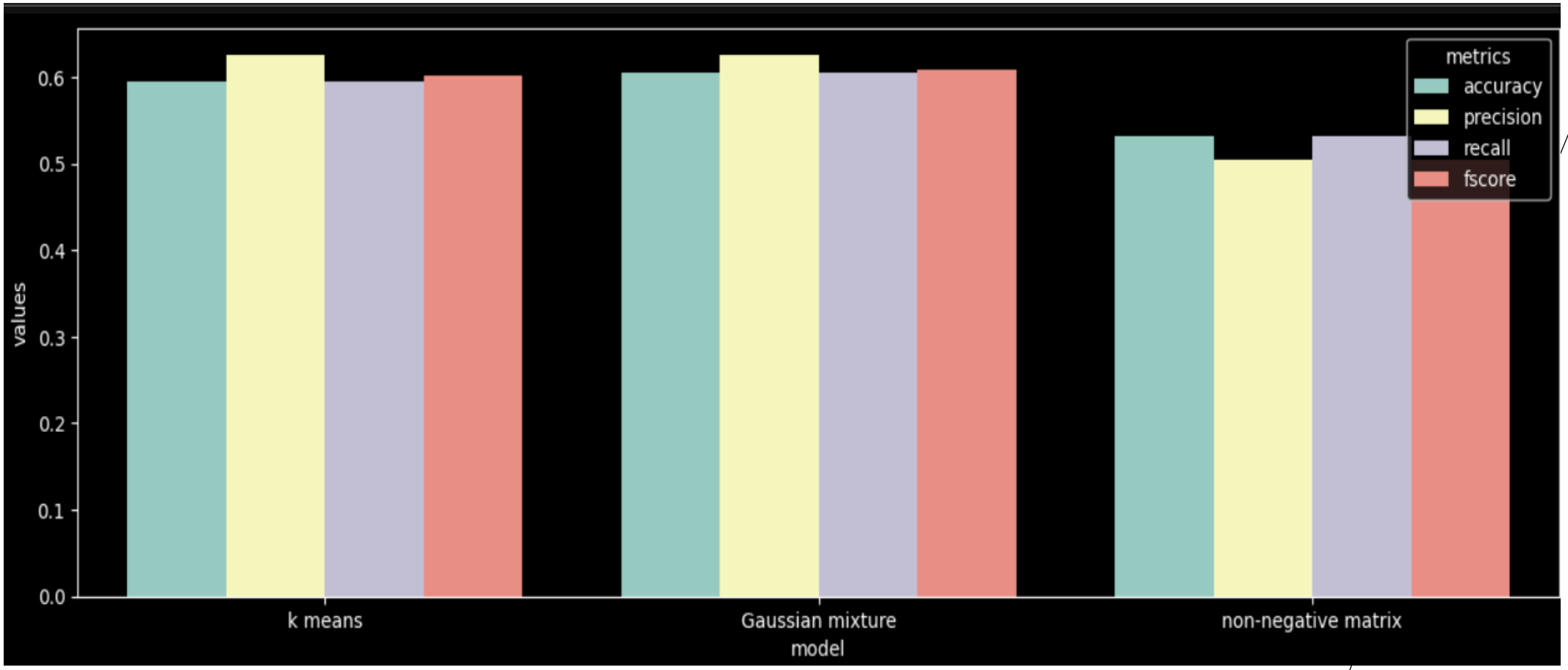
- **Non-Negative Matrix Factorization (NMF).**

  NMF was used to cluster the preprocessed data into three clusters.



SUMMARY OF RESULTS

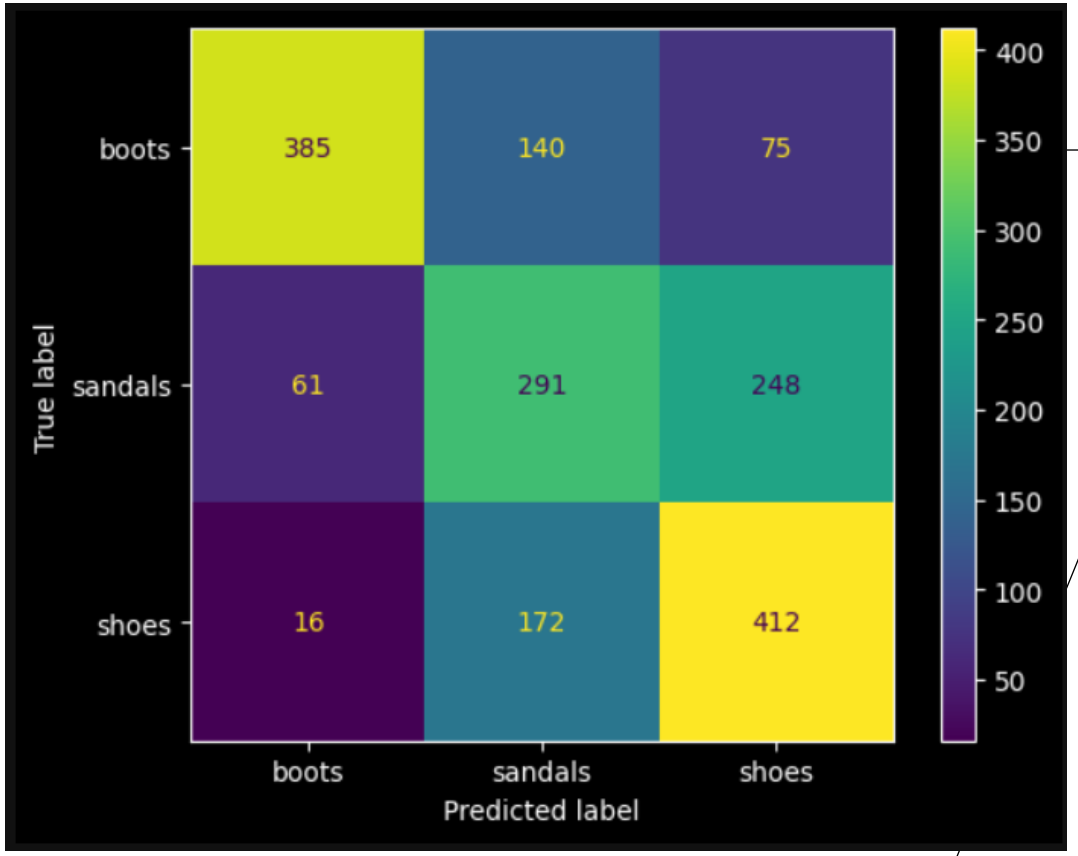
SUMMARY OF METRICS FOR EACH MODEL



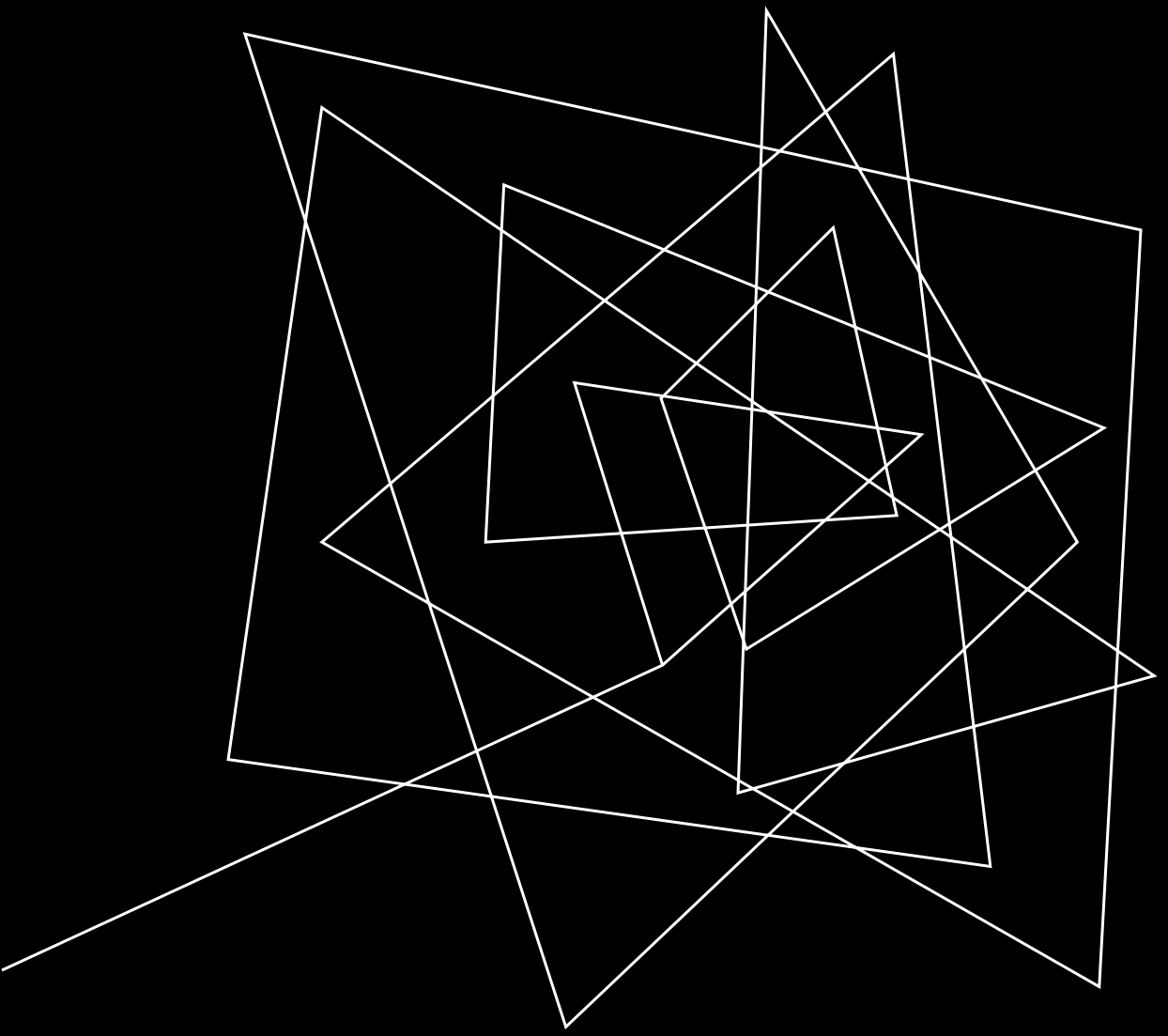
BEST MODEL: GAUSSIAN MIXTURE

Accuracy = 0.604
Precision = 0.625
Recall = 0.604
Fscore = 0.608

Among the clustering models considered, the Gaussian mixture clustering model achieve the higher accuracy, precision, recall and fscore.



Decision matrix computed on a test set for the Gaussian Mixture model.



CONCLUSION AND NEXT STEPS

CONCLUSION

We consider a dataset that includes images of boots, sandals, and shoes.

We train and test different clustering models, after doing some dimensionality reduction using PCA, with the aim to classify the images into their respective categories.

Among the clustering models considered (K means, Gaussian mixture, and Non negative Matrix factorization), Gaussian Mixture has the better performance, giving an average accuracy of 0.612 and fscore of 0.616.

All models considered seem to have problems to distinguish between shoes and sandals.

NEXT STEPS

To be able to train the models seamlessly in a laptop with 16gb of ram memory, we have only used a sample of the dataset and we have reduced the number of pixels of the images used.

With more computational resources a thorough exploration of different clustering models (like DBSCAN, Mean shift, etc) could be carried out.

A jupyter notebook with all of the computations can be found at https://github.com/adrian-pbustamante/Clustering-images-using-unsupervised-learning/blob/main/Clustering-images-with-unsupervised-learning.ipynb

THANK YOU

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