CSE 475 : Statistical Methods in AI **Monsoon 2019**

Assignment 2 : Face Classification/Verification

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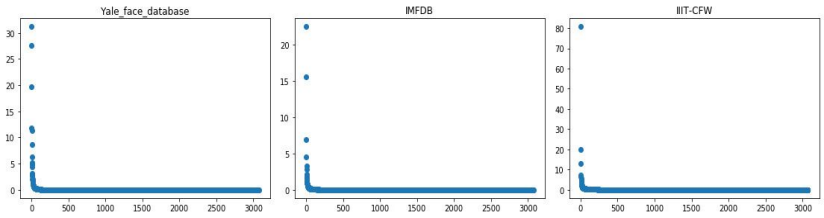
1. Eigen Faces

1.1 Introduction

Eigenfaces is the name given to a set of eigenvectors when they are used in the computer vision problem of human face recognition.The eigenfaces may be considered as a set of features which characterize the global variation among face images. Then each face image is approximated using a subset of the eigenfaces, those associated with the largest eigenvalues. These features account for the most variance in the training set.

1.2 EigenValue Spectrum



1.Yale Face Database

Fewer eigenvectors are required for accurate reconstruction because the primary components show high variance and it implies there is high importance to multiple components.

2.IMFDB

Fewer eigenvectors are required for accurate reconstruction because the first few primary components are close to each other i.e they capture a lot of the variance of the image.

3.IIIT-CFW

Large number of eigenvectors are required for reconstruction because the first component captures a lot of variance but the remaining vectors do not.

1.3 Reconstruction

1. **IIIT-CFW**: 328 eigen vectors are required for reconstruction.The error obtained is 0.06.

2.**IMFDB:**142 eigen vectors are required for reconstruction.The error obtained is 0.03.

3.**Yale_face:**69 eigen vectors are required for reconstruction.The error obtained is 0.04.

Yale_face requires less eigenvectors than IMFDB because real features have more

dense feature

Intuition: Yale_face requires less real faces which have more dense features with considerable variances so Yale_face requires less eigenvectors than IMFDB.

1.4 Difficult Persons/Identities

IMFDB:-

1.More eigenvectors are required for madhuri dixit.

2.Less eigenvectors are required for Katrina kaif.

2. Face Classification

The procedure for the face classification algorithm is:

1. Load the dataset
2. Split the data into training data and test data.
3. Do feature extraction.
4. Select a classifier and train the classifier on the train Data.
5. Validate the classifier on the test data and calculate the performance metrics.

various combinations of features and classifier types.

Classifiers : MLP,SVM,LR,Decision Tree VGG,Resnet

Features used : PCA,KPCA,LDA,KLDA,VGG,ResNet

1.Yale-face

3.IIIT-CFW

The best model is LDA+LR

3.TSNE FACE VISUALISATION

3.1 Dataset Visualisation

It is a reduction technique for Converting data to 2D or 3D.

4.KNN classifier

The procedure for this is:-

1.Load the dataset
2.Split the data into train and test data
3.Feature extraction
4.Validate the classifier.
5.Classifier:-KNN
6.Features used:-PCA,KPCA LDA,KLDA,

5.Extension/Application

IMFDB data is taken and label 0

The best model is PCA+LR

2.IMFDB

The best model is resnet+MLP classifier is used and resnet_features is used for Dimensionality reduction.

IMFDB data is taken and label 0 is given for film stars and label 1 is for politicians and MLP

Q2:-The best model and confusion matrix for Yale face and IMFDB

	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_pca+MLP	100	8.888888888888886	91.11111111111111	91.0952380952381
2	get_pca+Logistic_Regression	100	0.0	100.0	100.0
3	get_pca+SVM	100	46.666666666666664	53.333333333333336	54.8148148148148
4	get_pca+Decision_trees	100	22.222222222222214	77.77777777777779	76.76190476190476

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Yale_face_database
The best model is:-
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get_pca+Logistic_Regression

[[3 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 3 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 3 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 3 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 3 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 3 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 3 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 3 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 3 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 3 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 3 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 3 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 3 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 3 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 3]]
```

```
IMFDB
The best model is:-
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get_resnet_features+MLP

[[3 0 0 0 0 0 0 0]
 [0 3 0 0 0 0 0 0]
 [0 0 3 0 0 0 0 0]
 [0 0 0 3 0 0 0 0]
 [0 0 0 0 3 0 0 0]
 [0 0 0 0 0 3 0 0]
 [0 0 0 0 0 0 3 0]
 [0 0 0 0 0 0 0 3]]
```

IMFDB

	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_resnet_features+MLP	2048	0.0	100.0	100.0
2	get_resnet_features+Logistic_Regression	2048	0.0	100.0	100.0
3	get_resnet_features+SVM	2048	25.0	75.0	77.5
4	get_resnet_features+Decision_trees	2048	4.166666666666657	95.83333333333334	95.71428571428571

The best model and confusion matrix for IIIT-CFW

IIIT-CFW

	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_lda+MLP	7	8.333333333333343	91.66666666666666	91.54761904761905
2	get_lda+Logistic_Regression	7	4.166666666666657	95.83333333333334	95.71428571428571
3	get_lda+SVM	7	4.166666666666657	95.83333333333334	95.71428571428571
4	get_lda+Decision_trees	7	4.166666666666657	95.83333333333334	95.71428571428571

```
IIIT-CFW
The best model is:-
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get_lda+Logistic_Regression

[[3 0 0 0 0 0 0 0]
 [0 3 0 0 0 0 0 0]
 [0 0 3 0 0 0 0 0]
 [0 0 1 2 0 0 0 0]
 [0 0 0 0 3 0 0 0]
 [0 0 0 0 0 3 0 0]
 [0 0 0 0 0 0 3 0]
 [0 0 0 0 0 0 0 3]]
```

Q4:-The tables for all the combination of features and classifier(KNN)

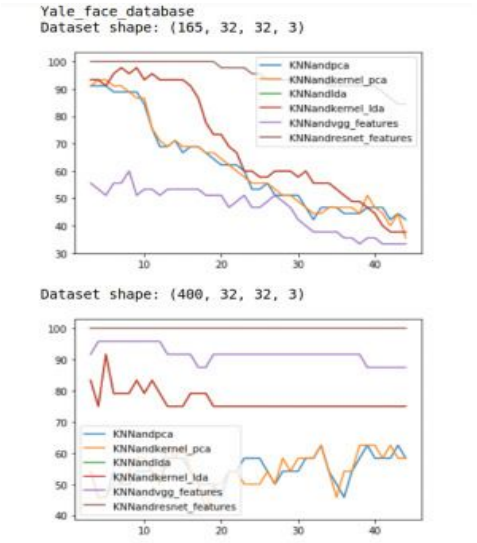
	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_pca+KNN	100	8.888888888888886	91.11111111111111	91.0952380952381
2	get_kernel_pca+KNN	100	8.888888888888886	91.11111111111111	91.0952380952381
3	get_lda+KNN	14	0.0	100.0	100.0
4	get_kernel_lda+KNN	14	0.0	100.0	100.0
5	get_vgg_features+KNN	4096	46.666666666666664	53.333333333333336	51.91534391534392
6	get_resnet_features+KNN	2048	0.0	100.0	100.0

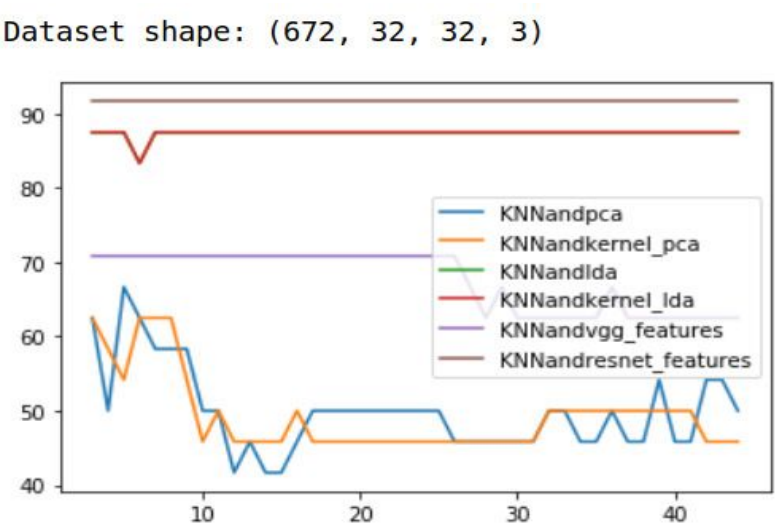
IMFDB

	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_pca+KNN	100	50.0	50.0	50.148809523809526
2	get_kernel_pca+KNN	100	54.166666666666657	45.83333333333333	44.25595238095239
3	get_lda+KNN	7	4.166666666666657	95.83333333333334	95.71428571428572
4	get_kernel_lda+KNN	7	4.166666666666657	95.83333333333334	95.71428571428572
5	get_vgg_features+KNN	4096	4.166666666666657	95.83333333333334	95.71428571428572
6	get_resnet_features+KNN	2048	0.0	100.0	100.0

IIIT-CFW

	Method	Reduced	Classification_error	Accuracy	F1-Score
1	get_pca+KNN	100	58.33333333333333	41.66666666666667	42.22222222222222
2	get_kernel_pca+KNN	100	62.5	37.5	39.16666666666667
3	get_lda+KNN	7	4.166666666666657	95.83333333333334	95.71428571428571
4	get_kernel_lda+KNN	7	4.166666666666657	95.83333333333334	95.71428571428571
5	get_vgg_features+KNN	4096	29.166666666666657	70.83333333333334	69.94047619047619
6	get_resnet_features+KNN	2048	8.333333333333343	91.66666666666666	91.42857142857143



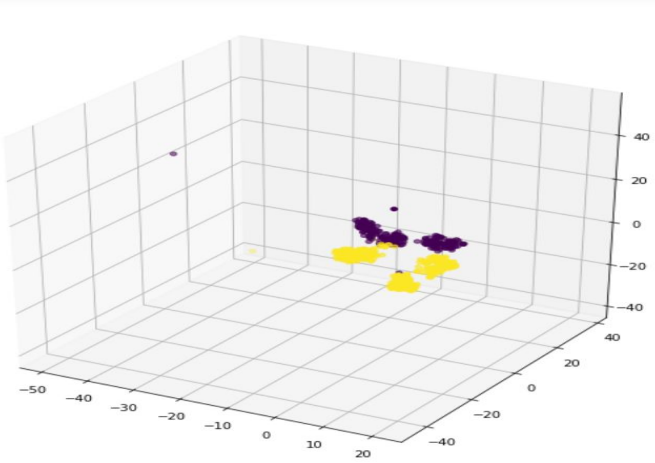


The above are the plots for K vs accuracy for each dataset

Q3.The scatter plot contains data points of one class are grouped together for TSNE Reduction.

Q5:-Resnet features is used because it gives high accuracy.

The scatter plot obtained is:-



Q4:- RECALL=(TP)/(TP+FN)

PRECISION=(TP)/(TP+FP)

When the dataset is skewed recall and precision come out as more supreme evaluation metrics.In this case the classes are balanced therefore I have used only accuracy metric.

Q5:-**Real Life Application**:-

Nowadays,with the participation of actors in politics many psychological studies have started to work on the influence of the stardom and fanbase of the filmstars on the voting power of the public and how the thinking power of the people changes.

So if the classifier has a weak confidence on classifying the person as an actor or politician , then that means the person in the image can be classified as belonging to both categories.So,to support the hypothesis the studies use weighted classification along with other factors

Steps to Follow:

1.The dataset is loaded

2.The labels should be changed i.e label 0 is given for film stars and label 1 is given for politicians.

3.Split the data into training and test data.

4.The dimensionality reduction is done using Resnet features.

5.The classifier used is MLP.

6.Three hidden layers are used and the size of the hidden layers are 1024,512,64.

7.Maximum iterations used are 200 and batch size is 20 and activation function used is Relu.

Metrics:

The accuracy obtained is nearly 100%.These results show that the classification results after only a few iterations of 200 on a small dataset give out near perfect results.