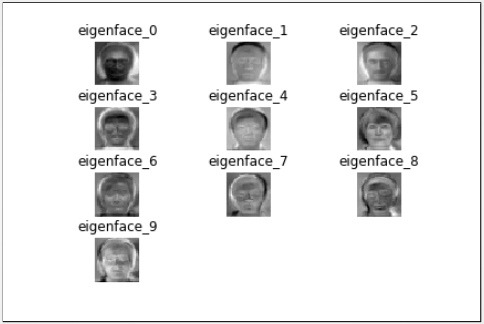
Computer Vision
Fall 2021
Problem Set #6

Ali Alrasheed
Ajar3@gatech.edu

1a: Average face

ps6-1-a-1

1b: Eigenvectors



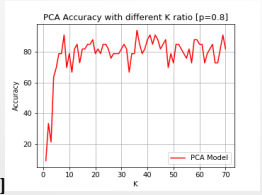
ps6-1-b-1

1c: Analysis

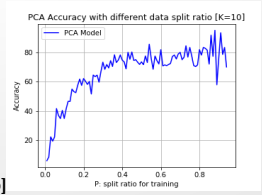
Analyze the accuracy results over multiple iterations. Do these "predictions" perform better than randomly selecting a label between 1 and 15? Are there any changes in accuracy if you try low values of k? How about high values? Does this algorithm improve changing the split percentage p?

The PCA classifier significantly outperform the random classifier. The random classifier accuracy was about %6 (expected about %6.67) while the PCA classifier (k=50,p=0.5) was able to achieve an accuracy of %80.72. In addition, the figure below labelled [a] shows the effect on the accuracy of the model when changing the k (the highest-k eigenvector/eigenvalues) while keeping p constant (p=0.8) . The figure [a] below shows that increasing K improves the accuracy of the PCA model, but it tends to saturate at around %80 to %85 (at k greater than 10). Similarly, the figure labelled [b] shows the effect on the accuracy when changing p while keeping k constant (k=10). As it can be seen from figure [b] that as the p value increases, the accuracy of the PCA model increases as well but it almost saturate when p is greater than 0.4.

[a]



[b]



(a)Different K (b) Different P

2a: Average accuracy

Report the average accuracy over 5 iterations. In each iteration, load and split the dataset, instantiate a Boosting object and obtain its accuracy.

Dataset: %80 training and %20 testing
Average accuracy of the training data:

Iteration	1	2	3	4	5	Average Accuracy
Random classifier	%48.88	%47.34	%48.88	%48.05	%51.41	%48.91
Weak classifier	%74.67	%76.86	%75.38	%75.27	%76.45	%75.72
Boosting classifier	%95.62	%93.24	%93.14	%97.23	%93.48	%94.52

Average accuracy of the testing data:

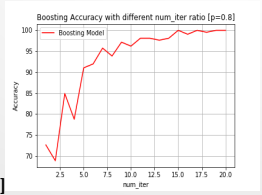
Iteration	1	2	3	4	5	Average Accuracy
Random classifier	%46.23	%50.47	%55.66	%48.05	%55.19	%51.11
Weak classifier	%75.0	%70.75	%75.0	%72.64	%70.28	%72.73
Boosting classifier	%96.23	%92.0	%91.98	%94.81	%90.09	%93.02

2a: Analysis

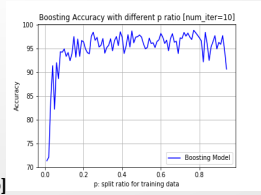
Analyze your results. How do the Random, Weak Classifier, and Boosting perform? Is there any improvement when using Boosting? How do your results change when selecting different values for num_iterations? Does it matter the percentage of data you select for training and testing (explain your answers showing how each accuracy changes).

It can be seen from the table in the previous page that the random classifier has the least accuracy in both the training and testing data with an average of %48.91 and %51.11 respectively. The weak classifier did reasonably well compared with the random classifier in both the training and testing data with an average accuracy of %75.72 and %72.73 respectively. However, Boosting classifier has outperformed both the random and the weak classifier achieving an average accuracy of %94.52 in training and %93.02 in testing data. In addition, it can be seen from the figure [a] below that increasing the num_iter increases the accuracy to almost %99. Similarly, figure [b] below shows that increase p also increases the model's accuracy. However, as long as the percentage is not too small (greater than 0.2), the accuracy of the boosting are very similar (saturate). For this specific dataset, it seems that the boosting model is less sensitive to the percentage of data for the training and testing, it only needs small number of example to be able to recognize the correct label.

[a]

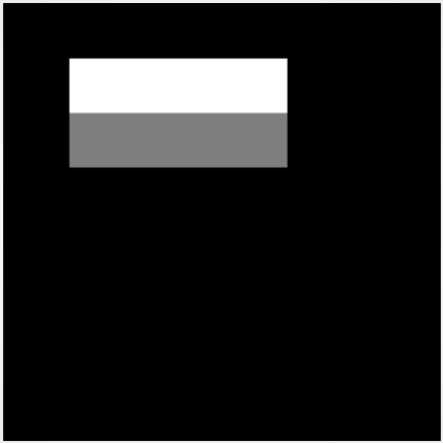


[b]



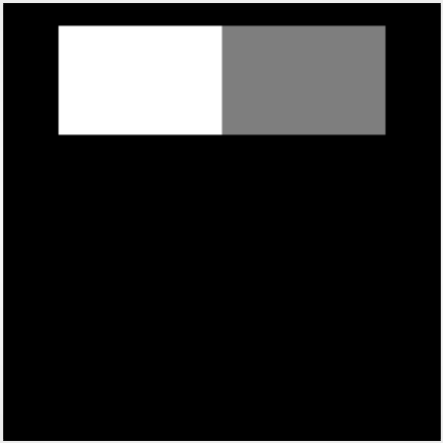
(a)Different num$_iter(b)Differentp$

3a: Haar Features



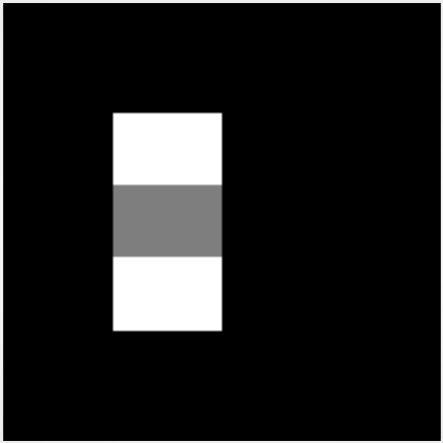
ps6-3-a-1

3a: Haar Features



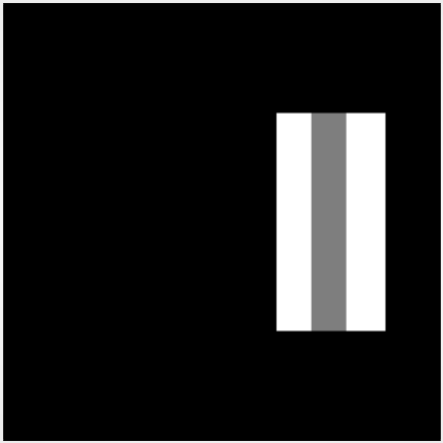
ps6-3-a-2

3a: Haar Features



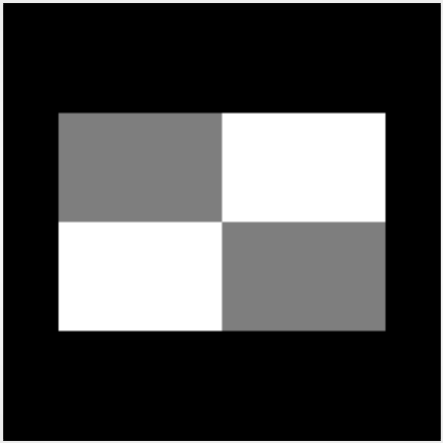
ps6-3-a-3

3a: Haar Features



ps6-3-a-4

3a: Haar Features



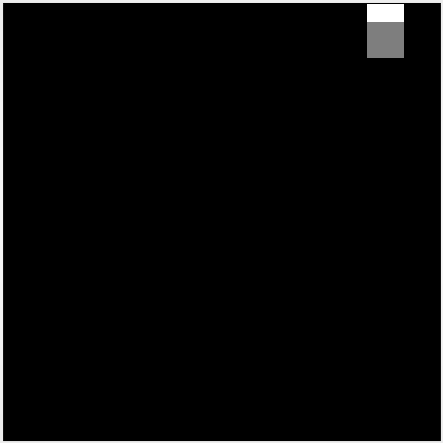
ps6-3-a-5

3c: Analysis

How does working with integral images help with computation time? Give some examples comparing this method and np.sum.

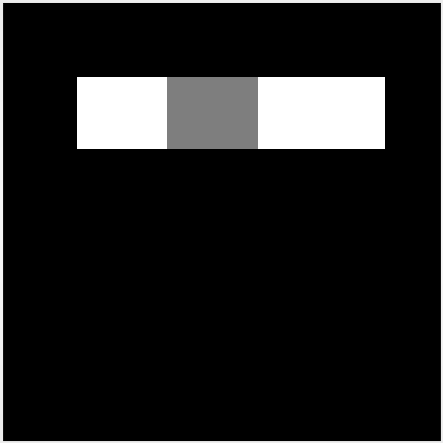
The np.sum from numpy can be definitely used in this assignment instead of the integral images, but it is not the most efficient way. The use of Integral images help significantly in optimizing the code in terms of computational time especially when dealing with large datasets. The reason for this is that using the integral images allows for the reuse of the calculations to compute the sum of the rectangle instead of computing the sum from scratch again.

4b: Viola Jones Features



ps6-4-b-1

4b: Viola Jones Features



ps6-4-b-2

4b: Analysis

Report the classifier accuracy both the training and test sets with a number of classifiers set to 5. What do the selected Haar features mean? How do they contribute in identifying faces in an image?

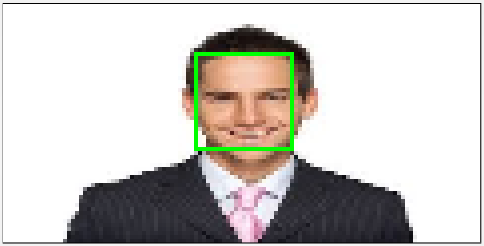
Accuracy for training and testing data using 5 weakclassifiers (Viola Jones):

Data	Accuracy
Training	%97.14
Testing	%75.77

The two Haar features shown previously represent the feature that produced the least error when classifying the face and non-face images in first two weak classifiers. These chosen Haar features per classifiers (one with lowest error) are the most important element for the deciding the class of the image. The features calculate scores per image and then used them to classify the image. The location of and size of these features allow finding the most important features of the faces such as eyes and eyebrow.

By looking at the first feature, it seems that is looking for the area of the right forehead of the face, while the second features is looking more for the eyes and eyebrows.

4c: Viola Jones Face Recognition



ps6-4-c-1

5b-1 Extra Credit: Cascade Classifier

Report the cascaded classifier accuracy on both the training and test sets. What was the best percentage for the train/test split? What values did you choose for the false positive target, the false positive rate, and the detection rate? What impact did these have on the overall cascaded classifier?

I think

my answer is ...

5b-2 Extra Credit: Cascade Classifier

How many classifiers did your cascade algorithm produce? How many features did each of these classifiers have? Compare this classifier to just a single Viola Jones classifiers.

I think

my answer is ...

5b-3 Extra Credit: Cascade Classifier Face Recognition

.

ps6-5-b-1