Computer Vision
Fall 2017
Problem Set #6

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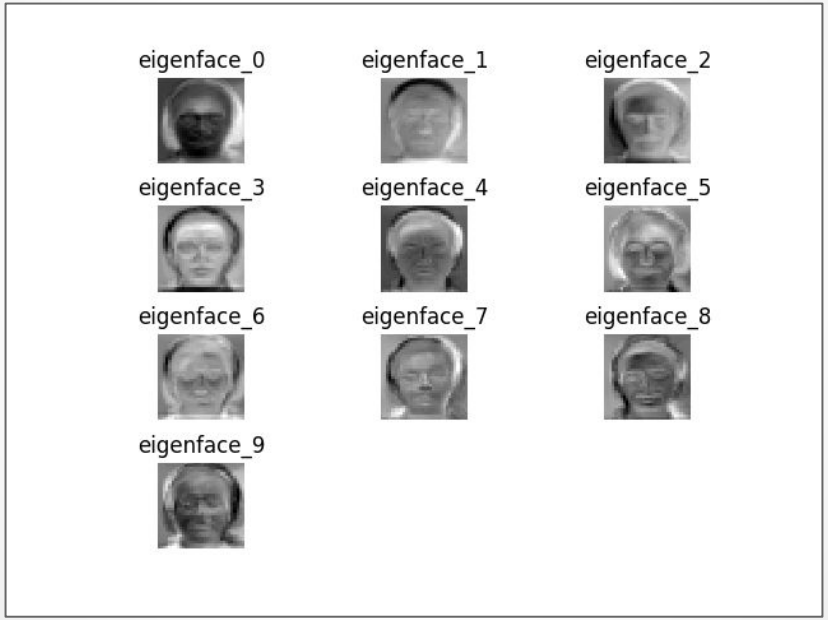
1a: Average face

ps6-1-a-1.png

1b: Eigenvectors



ps6-1-b-1.png

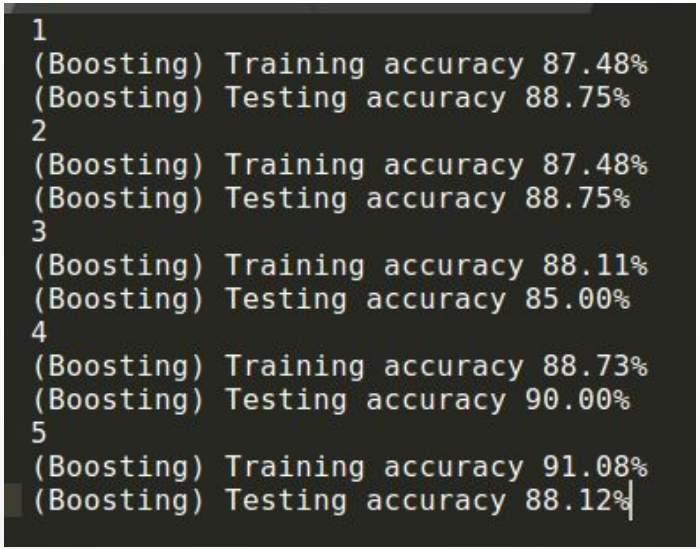
1c: Analysis

Generally the PCA algorithm performed slightly better than randomly selecting labels between 1 and 15 -- by returning at ~57% accuracy. Generally when randomly selecting labels, you will see a random dist. (50%).

Low values of k decreased the accuracy, while high values increased the accuracy. (k = 1 => 8.4%, k=25 => 75.90%). 50% split (p) generally provided the best accuracy values. When the split shifted towards either end of the range (.99 vs .1), it tended to be less accurate.

2a: Average accuracy

I posted a picture on the bottom right at each iteration (k =1, 2 .. 5). As you can see the training accuracy increases as k increases.



2a: Analysis

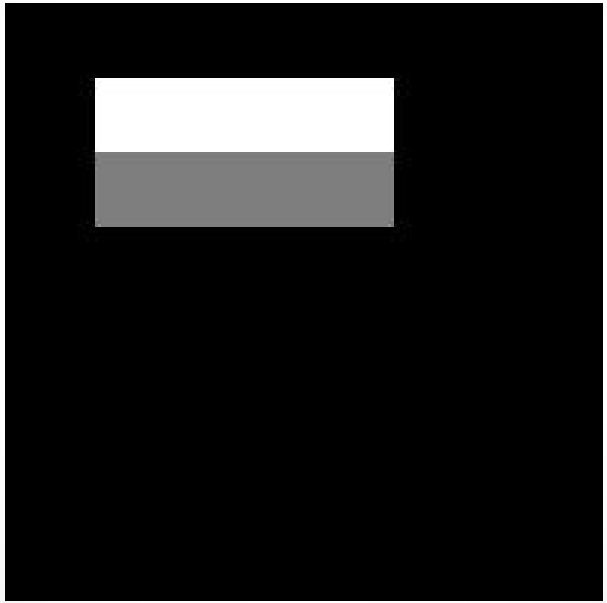
For the random test/training results they tended to hover around 50% as we would expect from a random choice distribution between -1 and 1. For the weak classifier we saw pretty consistent results, as the difference between the test and training set tended to be negligible. There is a definite improvement in accuracy from using boosting techniques as opposed to the weak classifier/random choices. There is also a great improvement in accuracy as k increases, as we start to see 90% accuracy rates as we get to 9 iterations.

```
(Random) Training accuracy: 50.39%
(Weak) Training accuracy 87.01%
(Random) Testing accuracy: 55.00%
(Weak) Testing accuracy 87.50%
```

```
1
(Boosting) Training accuracy 87.48%
(Boosting) Testing accuracy 88.75%
2
(Boosting) Training accuracy 87.48%
(Boosting) Testing accuracy 88.75%
3
(Boosting) Training accuracy 88.11%
(Boosting) Testing accuracy 85.00%
4
(Boosting) Training accuracy 88.73%
(Boosting) Testing accuracy 90.00%
5
(Boosting) Training accuracy 91.08%
(Boosting) Testing accuracy 88.12%
```

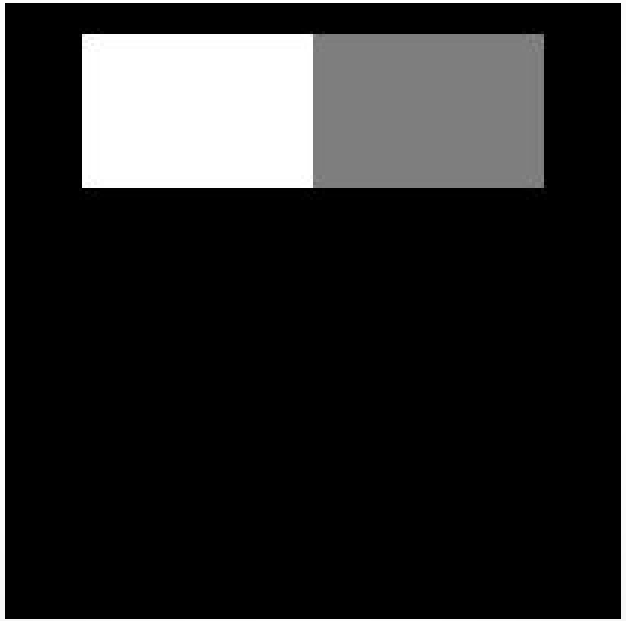
```
5
(Boosting) Training accuracy 90.30%
(Boosting) Testing accuracy 87.50%
6
(Boosting) Training accuracy 91.55%
(Boosting) Testing accuracy 88.75%
7
(Boosting) Training accuracy 94.84%
(Boosting) Testing accuracy 90.00%
8
(Boosting) Training accuracy 93.11%
(Boosting) Testing accuracy 90.62%
9
(Boosting) Training accuracy 95.93%
(Boosting) Testing accuracy 90.62%
```

3a: Haar Features



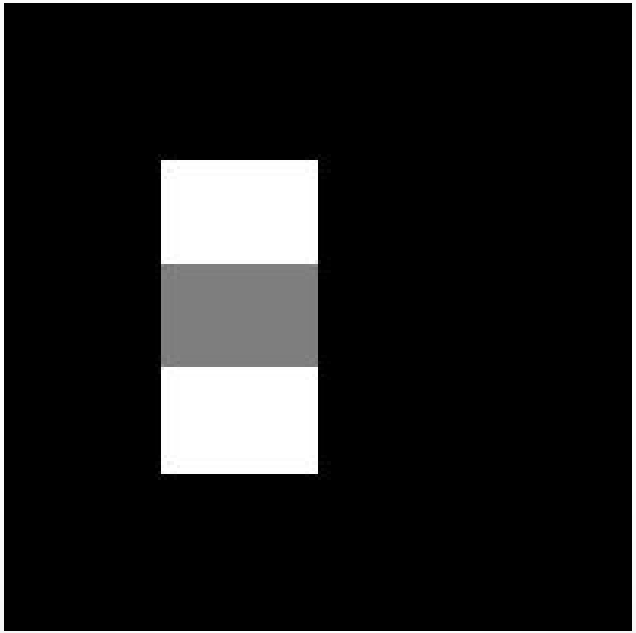
ps6-3-a-1.png

3a: Haar Features



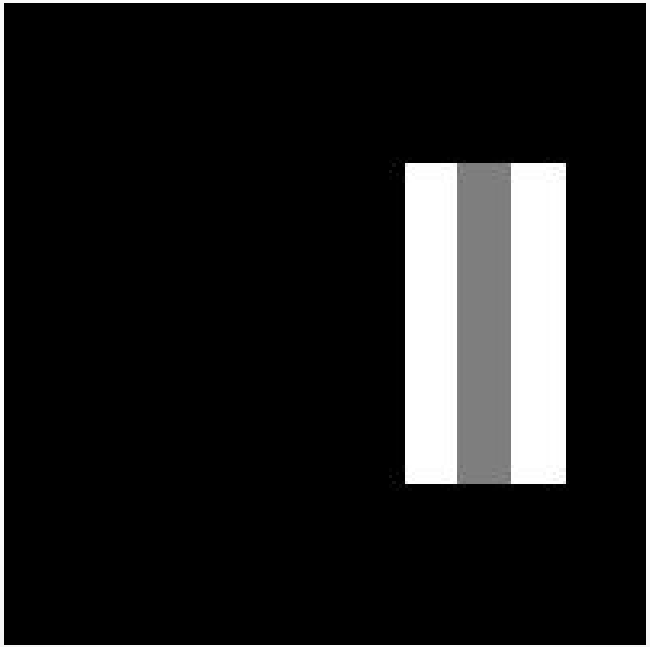
ps6-3-a-2.png

3a: Haar Features



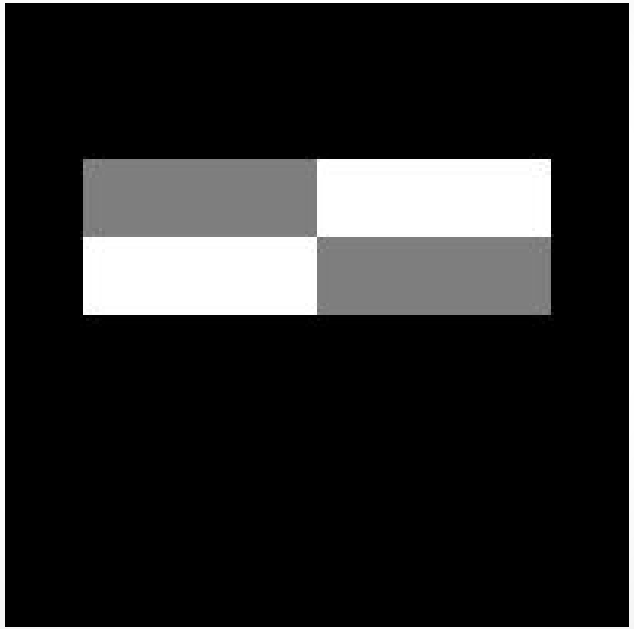
ps6-3-a-3.png

3a: Haar Features



ps6-3-a-4.png

3a: Haar Features



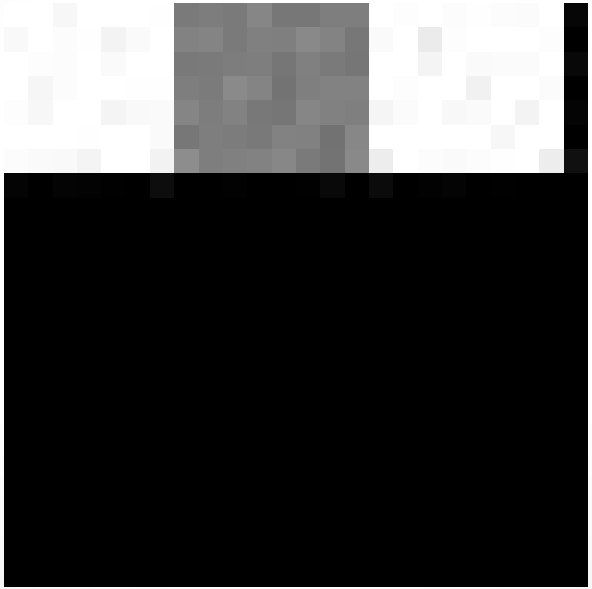
ps6-3-a-5.png

3c: Analysis

It takes considerably longer to compute the scores using np.sum() as opposed to a summed table (integral arrays). This is because np.sum() will recalculate the values every time for each position in the array (and whichever axises you choose). When you calculate the integral array once, the values are stored and always accessible in determining the area of a rectangle (since it is a composite function using other values already stored in memory).

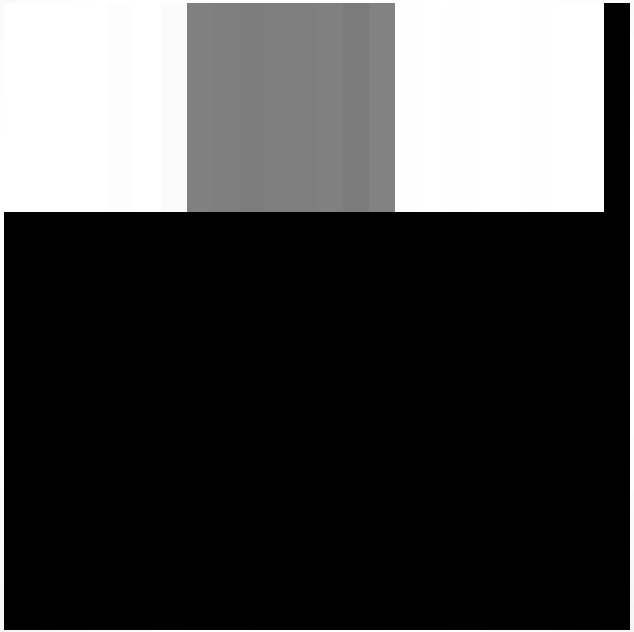
Take a 2d array with shape (200, 200). If we were to calculate use the D-B-C+A formula, we would need to calculate 4 numpy sums (given the coordinates) and we would also have to slice the array. If we use the integral approach, we can just use those points to find their corresponding values in the summed matrix (integral image matrix). This is considerably faster, and easy to compute using np.cumsum().

4b: Viola Jones Features



ps6-4-b-1.png

4b: Viola Jones Features



ps6-4-b-2.png

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?

The selcted haar features represent the best haar features that were used to find the images we need. I think this is why my test accuracy was off -- because my algorithm failed to find the best features used in tracking. What's interesting to note though is that my training accuracy was near perfect. Essentially these haar features are important because they are distilled filters that can be used to find faces in an image (by taking advantage of pixel intensity differences (gradients).

The classifier accuracies was:

Prediction accuracy on training: 100.00%
Prediction accuracy on testing: 42.86%

4c: Viola Jones Face Recognition

ps6-4-c-1.png