Homework 1

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Problem A.1. Matlab warmup

- `x=randperm(5);`

  Matlab randomly permutes integers from 1 to N, what you'd expect is a vector containing N number of integers in random order

- a is a 3x3 matrix, b is a row vector of the second row of matrix a. b = [4,5,6]

- g is an array of indices from entries of f satisfying the specified condition. h is an array of values in f (as indexed by g) which satisfies the condition.

- y is the sum of the entries in x, a 1x10 vector of values 22. y=220

- a is an increasing vector from 1 to 100, b is a decreasing vector from 100 to 1.

Problem A.2. Analyzing image using imread()

Figure 1: (a) A plot of the sorted intensities.

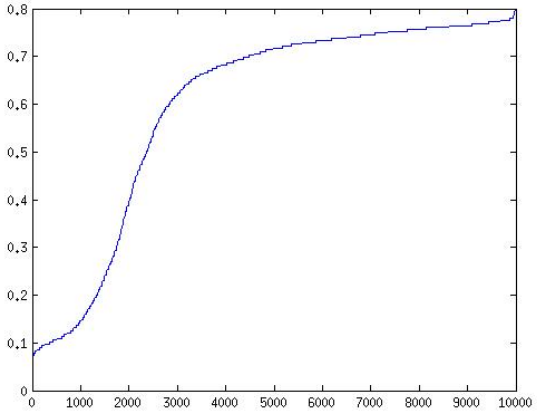


Figure 2: (b) A histogram of the intensities.

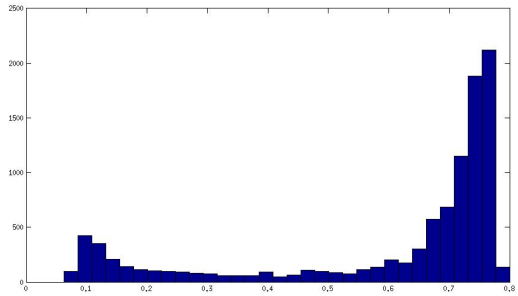


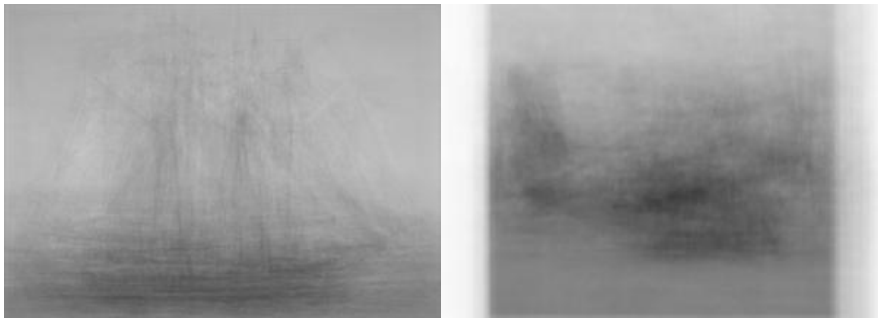
Figure 3: (c) A binary image using threshold t=0.7.

Problem B. Computing average images

1. Compute average image in gray scale

Figure 4: B1. Averaged image in gray scale

(a) ship (b) plane



2. Compute average image in RGB

Figure 5: B2. Averaged color image in RGB

(a) ship (b) plane

3. Compute average image with random horizontal mirror-flipping

Figure 6: B3. Averaged color mirror-flipped image in RGB

(a) ship (b) plane

4. why do the averaged mirror flipped images look different from the RGB averaged images?

- The averaged mirror flipped images actually look the same as the RGB averaged images.

Problem C. CIFAR image classification

Figure 7: C1. Display first airplane image in test set

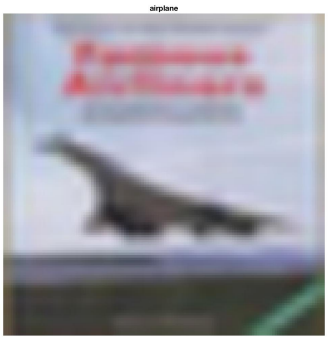


Figure 8: C2. Nearest neighbor classifier labels an airplane from the test set as automobile from the nearest training example

Figure 9: C3. Class confusion matrix for average accuracy of nearest neighbor classification: 9.8% using Euclidean distance, k=1 nearest neighbor

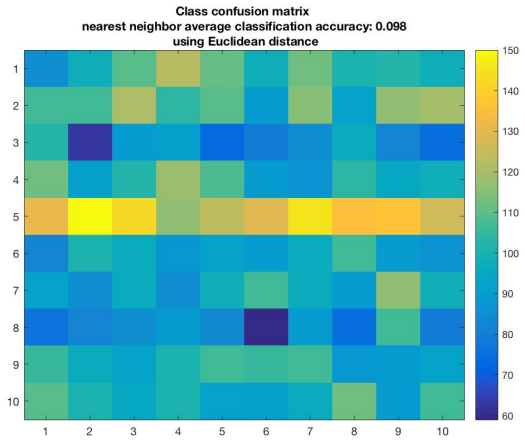


Figure 10: C4. Classification error for KNN

(a) knn=1 (b) knn=3 (c) knn=5

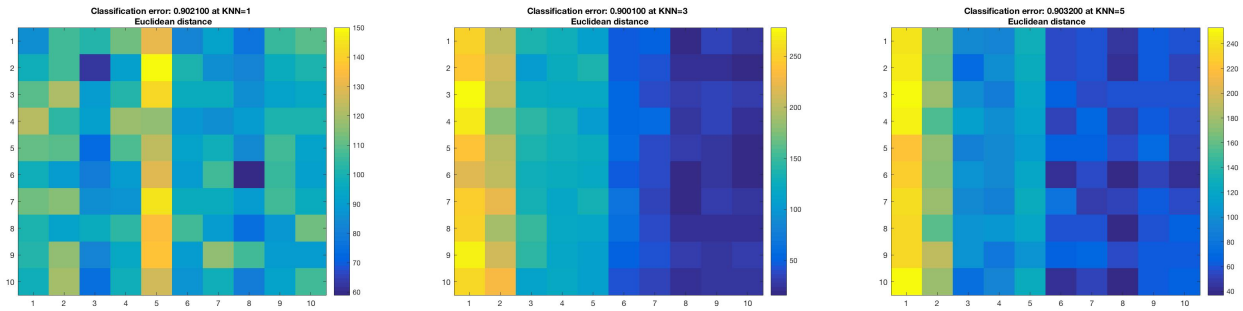
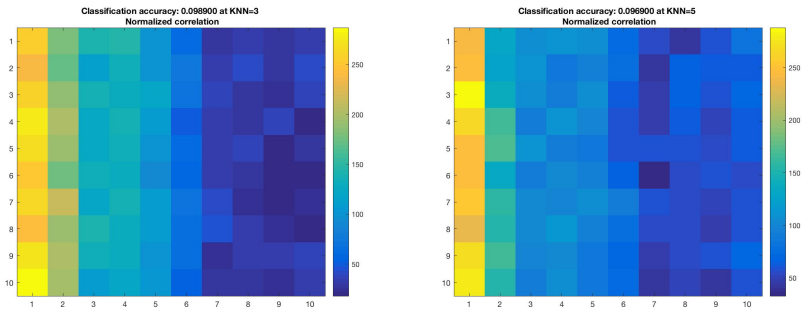


Figure 11: C5. Classification accuracy using Normalized Correlation

(a) knn=3 (b) knn=5

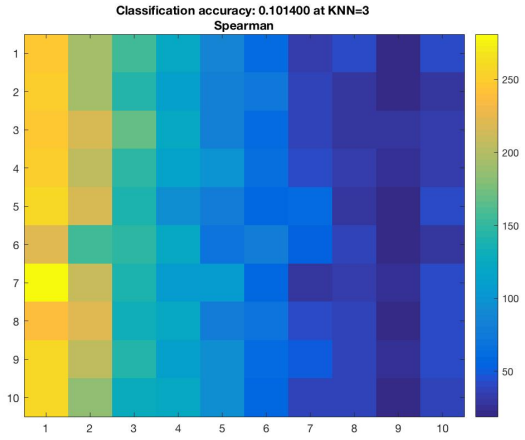


The best-performing system (the value of K, and the distance metric)? Provide some explanation as to why you think this combination performed best. Using your best-performing

combination, report which classes tend to get confused with each other. Show a few test images that were most easily confused for an incorrect class and explain why the confusion occurred.

- The best performing system is calculating the distance using Spearman correlation, which measures the strength and direction of associating between two vectorized images, with k=3 nearest neighbors.

Figure 12: C6. Classification accuracy 51 % for KNN=5 using Hamming distance



- The Spearman correlation outperformed Euclidean distance and normalized correlation because it uses rank efficient vectors in the high dimensional space. The correlation metrics preserves the relative structure of the RGB channels, so it is not classifying based on color closeness.

  The KNN classifier has a preference for labels 1 & 2 because when there is a tie, the mode function picks the lower number by default. This can be overcome by instituting a random number tie-breaker mechanism.