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Assignment 3:

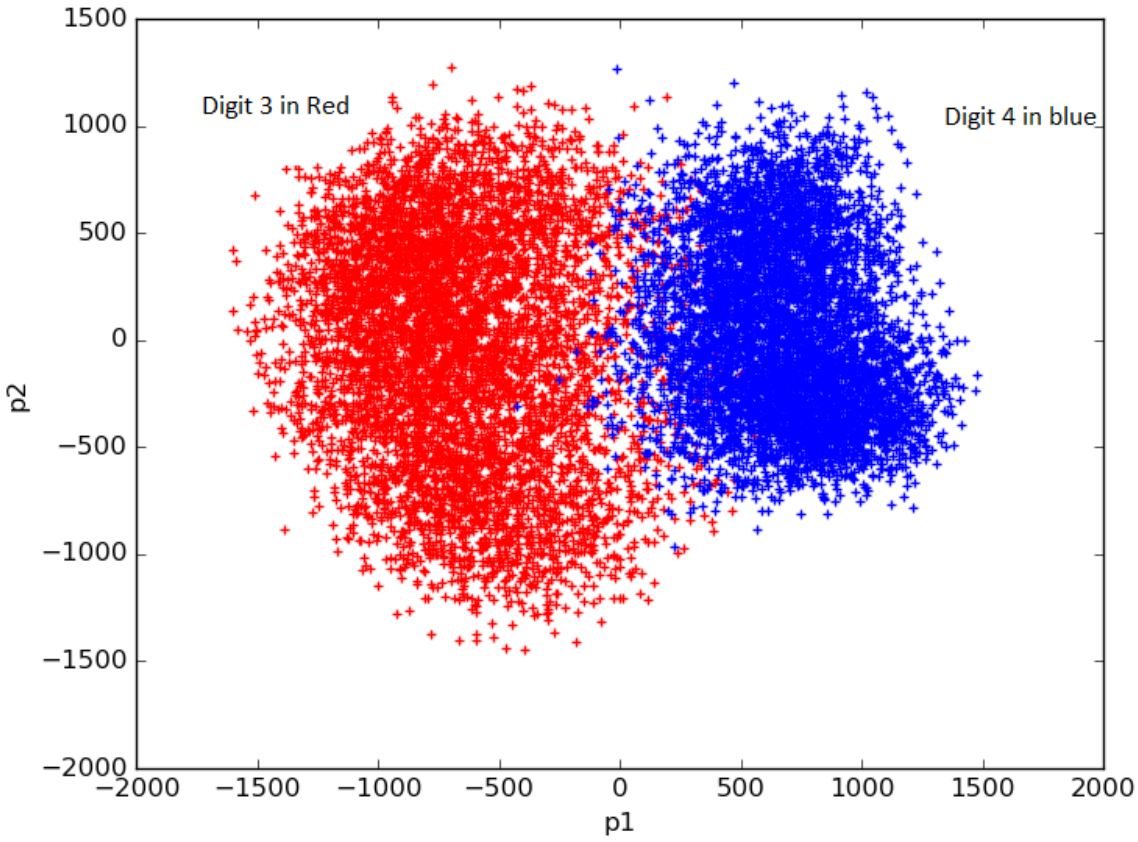
Used digits 3 & 4 from training set to build the classifier and used test data to test the classifier.

1. Data set used for training by filtering for digits 3 & 4.
   Total size: 60000
   Number of 3s: 6131
   Number of 4s: 5842
2. After PCA, original and reconstructed images. Reconstructed image doesn't compromise the identity of the samples, they are still readable to human eye.

   Original:

   Reconstructed:

3. Scatter plot for the PCA of digits 3 & 4. Digit 3 is plotted in RED and 4 in BLUE



4. Classifier results with histogram & Bayesian

Test data has 1010 number of 3s and 982 number of 4s.

Ground truth: 3 is (-) , 4 is (+)

From Testing Set	Histogram (Correct / Wrong / Indeterminate)	Bayesian (Correct / Wrong / Indeterminate)
Digit – 3	979 / 28 / 3	986 / 24 /0
Digit – 4	972 / 8 / 2	975 / 7 /0
Digits 3 & 4	1951 / 36 /5	1961 / 31 /0

Output Class---------->>	Positive		Negative	
Ground Truth	Histogram	Bayesian	Histogram	Bayesian
Positive	972	975	8	7
Negative	28	24	979	986

For digits 3 & 4 (first 2 rows above), both histogram & Bayesian classifier were able to classify the digits with error. Bayesian is able to classify all without any indeterminate state.

For all other digits excluding 3 & 4 (Row 4), both histogram & Bayesian classifiers failed. They classified all the inputs to either 3 or 4. Since the input is not 3 & 4, all are classified to wrong class labels.

5. Examples of correct & incorrect classifications

Histogram output	Bayesian output	Image tested
Incorrectly classified as 4	Incorrectly classified as 4	
Correctly classified as 3	Incorrectly classified as 4	
Incorrectly classified as 3	Correctly classified as 4	
Correctly classified as 3	Correctly classified as 3	
Correctly classified as 4	Correctly classified as 4	

6. Metrics

Ground truth: 3 is (-) , 4 is (+)

Metric	Histogram	Bayesian
Accuracy	0.9818	0.9844
Sensitivity	0.9918	0.9928
Specificity	0.9721	0.9762
PPV	0.9720	0.9759

Both histogram and bayesian classifiers were effective for PCA. Histogram had few indeterminate cases for some test input.