

ECEN 649 Homework #1: Naive Bayes and Perceptron

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All code along with sample output are available online at my github:

https://github.com/coltonriedel/pattern_recognition/

Problem 1

I did not use quantization in my approach. I did use Laplace (Lidstone) smoothing with a smoothing parameter equal to 1 (*i.e.* I added 1 to the numerator and 256 to the denominator of each conditional probability). When performing predictions I added the log of each probability to minimize errors due to loss of precision.

Output including priors, randomly selected conditional probabilities, and accuracy:

```
Parsed 60000 training set records in 1.55652 seconds
Parsed 10000 test set records in 0.249572 seconds
Trained model in 16.0305 seconds
```

Prior probabilities:

```
0: 0.0987167
1: 0.112367
2: 0.0993
3: 0.102183
4: 0.0973667
5: 0.09035
6: 0.0986333
7: 0.104417
8: 0.0975167
9: 0.09915
```

Randomly selected conditional probabilities:

```
P(x_517 = 218 | y = 6) = 0.000485909
P(x_41 = 197 | y = 7) = 0.000153351
P(x_6 = 128 | y = 7) = 0.000153351
P(x_627 = 82 | y = 2) = 0.0024139
P(x_289 = 122 | y = 7) = 0.000613403
P(x_442 = 70 | y = 9) = 0.000483481
P(x_468 = 250 | y = 9) = 0.000805802
P(x_745 = 70 | y = 9) = 0.000322321
P(x_73 = 198 | y = 8) = 0.000163747
P(x_702 = 107 | y = 5) = 0.000176149
```

Evaluated 10000 test records in 0.279734 seconds with 83.63% accuracy

Digit	Precision	Recall
0	0.889796	0.91023
1	0.970925	0.860938
2	0.790698	0.893757
3	0.826733	0.766055
4	0.822811	0.82449
5	0.674888	0.775773
6	0.889353	0.884735
7	0.838521	0.912169
8	0.779261	0.791449
9	0.847374	0.752641

Problem 2

Output including weights, bias, and accuracy:

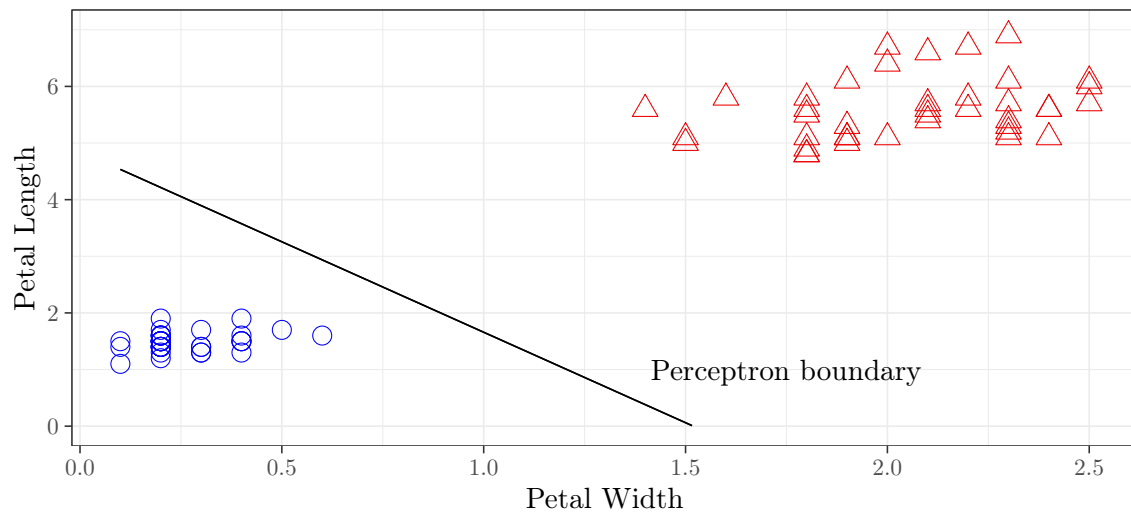
```
Parsed 75 training set records in 0.000129694 seconds
Parsed 25 test set records in 3.8692e-05 seconds

Trained perceptron with 1 iterations in 4.958e-06 seconds

Evaluated 25 test records in 1.746e-06 seconds with 100% accuracy
Weights:  $y = x_1 * (0.41) + x_2 * (1.31) + -1.99$ 
```

Plots of training set and test set data, with perceptron boundary ($z = 0$) shown:

Iris Training Dataset



Iris Test Dataset

