CSC411: Assignment 2

Due on Sunday, November 12th, 2017

Student Name: **Gokul K. Kaushik**

Student Number: **999878191**

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1 - Class Conditional Gaussians

1 - Using Bayes rule to derive an expression for $p(y = kx, \mu, \sigma)$

2 - Expression for the negative likelihood function (NLL)

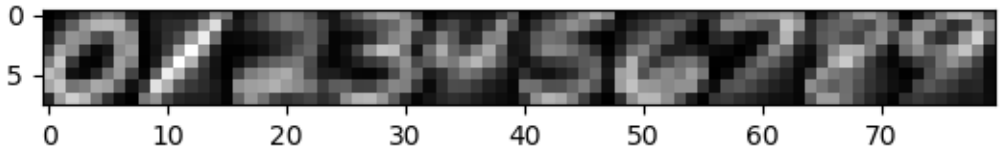
3 - Partial Derivatives of the Likelihood

4 - Find the maximum likelihood estimates for μ and σ

2 - Handwritten Digit Classification

0 - Loading the data and Plotting the Feature Means

The means (from 700 samples per digit) for each feature (64 features in total for an 8-by-8 pixel image) for 10 digits (digit 0 to digit 9) are plotted below:



1 - K-NN Classifier

Train and Test Classification Accuracy for K=1 and K=15

	Accuracy	
K Value	Train Classification	Test Classification
K = 1		
K = 15		

Tie Breaker Method

There are cases in K-Nearest Neighbours where there isn't one most frequent neighbours (there might be two neighbours that occur equally frequently).

Therefore, in such cases a tie breaking decision needs to be made. I have chosen to reduce the number of nearest neighbours by one - **effectively removing the last neighbour and repeating the check until a decision can be made**.
The algorithm's psuedo-code is:

```
Data: K Nearest Neighbours Array with a tie
Result: Nearest Neighbours Decided
initialization;
while not at end of this document do
    read current;
    if understand then
        go to next section;
        current section becomes this one;
    else
        go back to the beginning of current section;
    end
end
```

Algorithm 1: How to write algorithms

This method was chosen because:

1. The tie remains until the *most distant* neighbour from one of the most frequent neighbours is removed. This rewards the neighbour with the closest value in such cases.
2. This decision making method is intuitive to understand and easy to implement.

2 - Conditional Gaussian Classifier Training

3 - Naive Bayes Classifier Training

4 - Model Comparison