

# STAT 102B: Homework 3

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Due electronically through **BruinLearn**  
on May 19 at 11 pm

## Problem 1:

Consider a subset of the MNIST data set. The original data set is a widely used database of handwritten digits (0-9) used to train and test image classifiers. It consists of 70,000 images, 28x28 pixels each. The images are grayscale and have been pre-processed to ensure consistency.

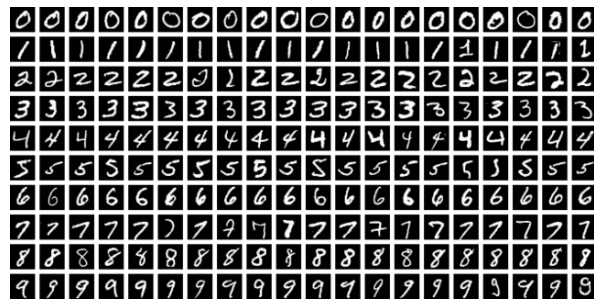


Figure 1: Handwritten digits in the MNIST data set

For this homework the digits **3**, **4**, **5** and **9** have been selected and split into training, validation, and test sets.

## Part (a):

Train and test the performance of a single layer MLP for the following two classification tasks using a binary cross-entropy loss function.

- Train the single-layer MLP to classify digits 3 and 5.

- Select the MLP that performs the best based on the validation set for the mini-batch size  $s = 64, 128, 256$  and the dimension of the hidden layer  $64, 128, 256$ . Fix the number of epochs to 30.
- Report the performance of the best performing MLP in the test data set by plotting the ROC curve and calculating the AUC.
- Repeat the exercise to classify the digits 4 and 9.

Comment on the results.

**Part (b):**

Compare the performance of the best single-layer MLP you have trained for the two classification tasks to that of logistic regression.

Specifically, train logistic regression on the train data set and test its performance on the test data set. Plot its ROC and calculate its AUC.