In this homework assignment, you will download the MNIST DATABASE of handwritten digits in the green box below on website <a href="http://yann.lecun.com/exdb/mnist/">http://yann.lecun.com/exdb/mnist/</a> to solve the following problems.

(Hint: Try to download the dataset directly in the program with code will be easier. )

## THE MNIST DATABASE

# of handwritten digits

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The MNIST database of handwritten digits, available from this page, has a training set of 60,000 examples, and a test set of 10,000 examples. It is a subset of a larger set available from NIST. The digits have been size-normalized and centered in a fixed-size image.

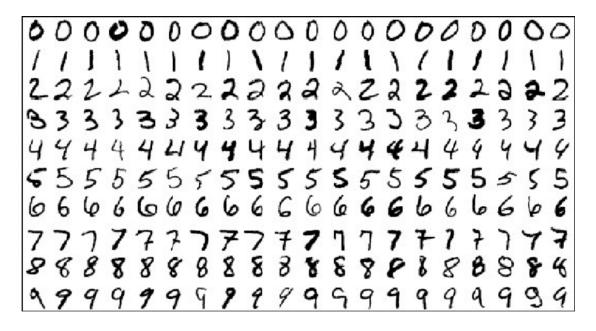
It is a good database for people who want to try learning techniques and pattern recognition methods on real-world data while spending minimal efforts on preprocessing and formatting.

Four files are available on this site:

t<u>rain-images-idx3-ubyte.gz</u>: training set images (9912422 bytes) t<u>rain-labels-idx1-ubyte.gz</u>: training set labels (28881 bytes) t<u>10k-labels-idx1-ubyte.gz</u>: test set images (1648877 bytes) t<u>10k-labels-idx1-ubyte.gz</u>: test set labels (4542 bytes)

#### The explanation of database as follow:

The MNIST database of handwritten digits, has a training set of 60,000 examples, and a test set of 10,000 examples. It is a subset of a larger set available from NIST. The digits have been size-normalized and centered in a fixed-size image.



#### Analysis the data.

### PLZ Mark The Question Number Clearly!

(Hint: For doing this homework, you can use "Google Colaboratory" for free GPU to overcome the difficulties of computer hardware if you need it!)

- 1. Try to print out 0~9 so that knowing the things you are going to input in the model.
- 2. Using CNN for handwriting recognition. <u>PLZ give the reason why you choose the specific Loss function, Optimizer, etc.</u>
- 3. Try to print out some output to make sure it is right.
- 4. Use ROC, recall... to see the model performance.