# 1 Introduction

The aim of this project is to implement different conventional classifiers to achieve hand-written digits recognition. The whole pipeline is described in the following section.

# 2 Classifiers

**SVM** Implement linear SVM on MNIST dataset. You can use any online toolbox for this, e.g. LIBSVM (`https://www.csie.ntu.edu.tw/~cjlin/libsvm/`) or MATLAB built-in function. You can apply PCA and LDA here to reduce feature's dimension.

**Deep Learning** Build a Convolutional Neural Network. Train it on MNIST training set and test it on testing set. You can design your architecture or use the architecture introduced in LeCun's paper [1]. You can use any of the following toolboxes:

    Caffe If you are Linux or OSX user, you can follow the instruction from `http://caffe.berkeleyvision.org` to install it.

    LightNet[2] It is a pure MATLAB toolbox. If you are a Windows user, this is an alternative choice. You can download it from `https://github.com/yechengxi/LightNet` and the tutorials are also included.

    Deep Learning Toolbox It is a pure MATLAB toolbox. If you are a Windows user, you can also try this. You can download it from `http://www.mathworks.com/matlabcentral/fileexchange/38310-deep-learning-toolbox`. However, the original version may not be enough to build your CNN, we add some features for you and upload it on canvas (DeepLearningToolboxSupplementary.zip).

# 3 Datasets

You can download **MNIST** from `http://yann.lecun.com/exdb/mnist/`. The description of Dataset is also on the website. Basically it has a training set with 60000 28 x 28 grayscale images of handwritten digits (10 classes) and a testing set with 10000 images.

# 4 Submission Guidelines

In this project, you can use any programming language you want, such as Matlab(recommend), C++, Python, ...etc. You need to submit your project in the following structure: A zip file with the name **YourDirectoryID_Proj2.zip** on to ELMS/Canvas. A main folder with the name **YourDirectoryID_P2** and the following sub-folders/files:

    **Code** A folder contains all your code

**Report** Your report should be in pdf format and no more than 5-6 pages(excluding figures). You should concentrate on the employed methods, the experiments and discuss the result you have obtained.

**Readme** A .txt file describing how to run your code.

# References

[1] Y. Lecun, L. Bottou, Y. Bengio, and P. Haffner. Gradient-based learning applied to document recognition. *Proceedings of the IEEE*, Nov 1998.

[2] Chengxi Ye, Chen Zhao, Yezhou Yang, Cornelia Fermüller, and Yiannis Aloimonos. Lightnet: A versatile, standalone matlab-based environment for deep learning. In *Proceedings of the 2016 ACM on Multimedia Conference*, MM '16, New York, NY, USA, 2016. ACM.