# MNIST Handwritten Digit Recognition

## Introduction

Handwritten digits recognition could be a well-researched subarea among the sphere that's involved with learning models to differentiate pre-segmented written digits. it's one among the foremost necessary problems in knowledge mining, machine learning, pattern recognition together with several different disciplines of computer science .

The main application of machine learning strategies over the last decade has determined efficacious in conformist decisive systems that are competitor to human performance and which accomplish so much improved than manually written classical artificial intelligence systems employed in the beginnings of optical character recognition technology. However, not all options of these specific models are antecedently inspected. An excellent try of researcher in machine learning and data processing has been contrived to realize economical approaches for approximation of recognition from data.

In 21st century written digit communication has its own normal and most of the days in standard of living are being employed as means that of voice communication and recording the knowledge to be shared with individuals. One among the challenges in handwritten characters recognition entirely lies within the variation and distortion of handwritten listing as a result of distinct community could use various type of handwriting, and management to draw the similar pattern of the characters of their recognized script. Identification of digit from wherever best discriminating options are often extracted is one among the main tasks within the space of digit recognition system. To find such regions totally different quite region sampling techniques are employed in pattern recognition.

The challenge in written character recognition is principally caused by the big variation of individual writing styles. Hence, strong feature extraction is extremely important to boost the performance of a handwritten character recognition system. These days handwritten digit recognition has obtained heap of concentration in the area of pattern recognition system sowing to its application in various fields. In next days, character recognition system may function as a cornerstone to initiate paperless surroundings by digitizing and process existing paper documents.

## MNIST Dataset

The **MNIST database** (*Modified National Institute of Standards and Technology database*) is a large database of handwritten digits that is commonly used for training various image processing systems. The database is also widely used for training and testing in the field of machine learning. It was created by "re-mixing" the samples from NIST's original datasets. The creators felt that since NIST's training dataset was taken from American Census Bureau employees, while the testing dataset was taken from American high school students, it was not well-suited for machine learning experiments. Furthermore, the black and white images from NIST were normalized to fit into a 28x28 pixel bounding box and anti-aliased, which introduced grayscale levels.

The MNIST database contains 60,000 training images and 10,000 testing images.Half of the training set and half of the test set were taken from NIST's training dataset, while the other half of the training set and the other half of the test set were taken from NIST's testing dataset.

## Analysis of MNIST Data Set with FCN and CNN

The MNIST data set gives a maximum accuracy of 87% generally with algorithm including SVM, RF and  Naïve Bayes. Two algorithms were tested with the dataset: Fully Convolutional Network and Convolutional Neural Network. The training and testing was done and CNN was found to have the highest accuracy of 98% approximately. Therefore it was used for the model.