# NEURAL NETWORK SIMULATION USING MATLAB

## INTRODUCTION

The following project is a simulation of a very simple Neural Network on the MNIST digit dataset to demonstrate the basic principles of a feedforward neural network. Unlike the deep-learning tutorial given on MATLAB@ official we have shown the elements of a simple feedforward network and used it to classify digits from images. This was done by Madhav Aggarwal (106118053) and Aananth V. (106118103) as an assignment for Soft Computing (CSHO17).

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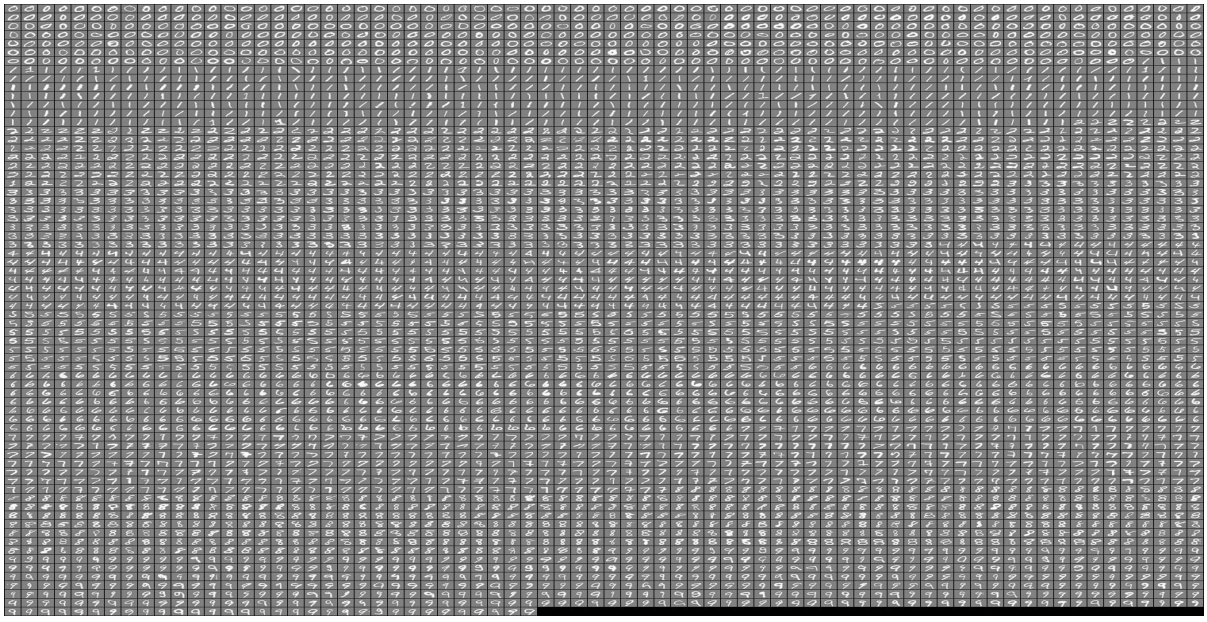
## INPUTS

We have used the **sigmoidal** function and a simple **softmax** classifier to classify the output class. We are loading 400  layer data with 10 output labels for training. The input layer has 400 nodes. Hidden layer has 25 nodes and final outputs are 10. Regularization Factor $\lambda = 3$.



## CONTENT

**Training**: The Train Files Folder contains 5 main documents. In order to train your network, run the ***train.m*** file. The

- **lrCostFunction.m**: We have defined variables theta, x, y, lambda and computed the squared loss function with L1 regularization.
    - $1/m\ (\Sigma(-y) * log(\sigma) - (1-y) * log(1-\sigma)\ +\ \lambda$
    - We then compute the gradient using Backprop.
- **fmcing.m**: An optimisation file directly taken from the internet in order to minimize a continuously differentiable multivariate function.
- **oneVsAll.m**: Converts the digits to a 9x1 array with each digit representing the class which the digit represents.
    - We use the fmcing function.
- **predictOneVsAll.m**: The 9x1 array the element having the maximum value is representative of the class it belongs to.
- **train.m**: Calls the above functions to make the final predictions. Input Layer size is 400 and number of labels are 10. We randomly check for different digits.

**Testing**: The Test Files Folder contains 2 main documents. To test your network please run the ***test.m*** file. The

- **predict.m:** Predicts based on the value with the 1 in the 9x1 array.
- **test.m**: This file tests the network it randomly generates the digit images and calls the predict function to predict which digit it is.

Apart from this we have a couple of common files:

- **displaydata.m**: This is to display the digits on the same image. Calculating the height and width of the input image scaling and displaying it.
- **weights.mat**: Weights for the neural network.
- **data.mat**: Actual data used as input for training.

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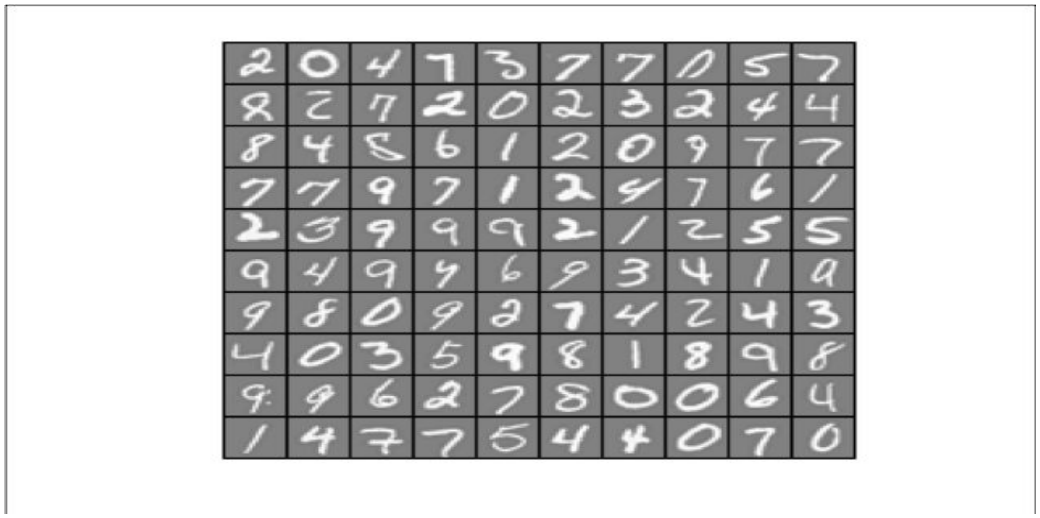
## PERFORMANCE

I. Achieved **80%** accuracy.



II. Output can also be viewed under the **"Results"** Folder.

III. Comparative study has been done with the MATLAB official documentation which can be executed and viewed from "matlabgivenexample.m".