Mini Project
5th Semester
Digit Recognition

Instructions:-

1. You should use MATLAB for this problem.
2. Train a neural network with one hidden layer using the back-propagation algorithm. You should implement the algorithm from first principles and not use any existing MATLAB modules.

In this problem, you are given the MNIST handwritten digit dataset (mnsit_all.mat) that contains 60K training and 10K testing examples of handwritten digits. Each example in the dataset is represented by 784 features corresponding to (28×28) pixel values ($[0, 255]$). The classes are 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 corresponding to each digit. Examples are partitioned based on the class to which they belong. We will implement the neural network learning algorithm (using back-propagation) to recognise the digits given the pixel values.
[READ :- Artificial neural network, paper]

a) Write a script to visualise the digits in the data. Your script should take a file/example index and display the image corresponding to the gray scale pixel values.

b) Extract the data for classes 3 and 8 from the original mnist_all.mat file to create a new mnist_bin38.mat file for binary classification. Train a neural network with one hidden layer (with 100 units) using the back-propagation algorithm. You should implement the algorithm from first principles and not use any existing matlab modules. Use the stochastic gradient version of the algorithm. Use a variable learning rate given as $\alpha_t = \frac{1}{\sqrt{t}}$ where t denotes the number of learning iterations. Choose an appropriate stopping criteria based on the change in value of the error function. Report the stopping criteria that you chose.

c) Report your accuracies over the test set using the learned network. Also report the training times of your algorithm.

d) Train the neural network classifier on the original multi-class MNIST dataset with the same experimental settings as in the binary case above. How many output units would you need in this case? Report the accuracies over the test set. Do you see any difference in training times compared to the binary setting?