EEL709: Assignment 3

Neural Networks for a multiclass classification

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I. Neural Networks

A. Hidden Layers

Number of hidden layers is first varied to see the changes in accuracy and time taken.

Number of neurons = 10
Activation Function = logsig

Hidden Layers	test accuracy	training accuracy	Time taken
1	95.3%	96.70%	10 s
2	96.7%	96.30%	30 s
5	89.4%	97.50%	58 s
10	85.3%	98.40%	2 m 32 s

B. Hidden Neurons

Number of hidden neurons in each layer is first varied to see the changes in accuracy and time taken.

Number of layers = 10
Activation Function = logsig

Hidden Neurons	test accuracy	training accuracy	Time taken
10	96.7%	96.30%	30s
50	98.50%	98.90%	31s
100	95.20%	99.35%	1 m 23 s
500	93.10%	100%	3 m 57 s

C. Changing Activation function

Activation function	test accuracy	Time taken
Tanh	96.1%	29 s
logsig	96.70%	30 s
softmax	95.8%	32 s

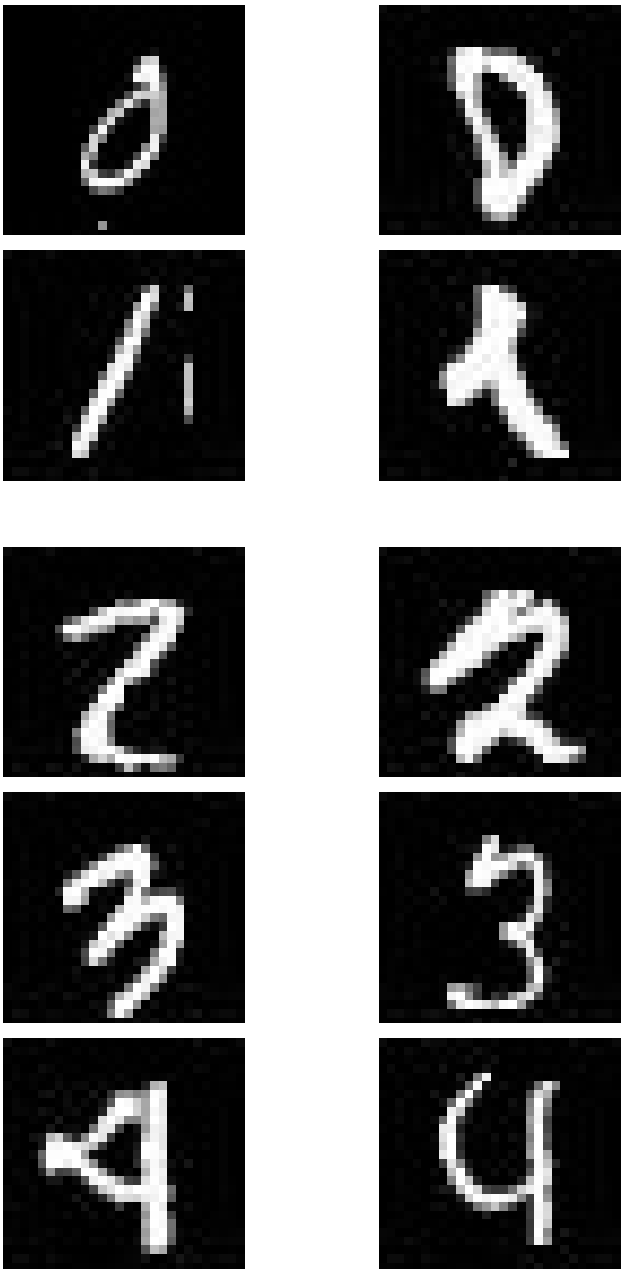
II. Interpretation

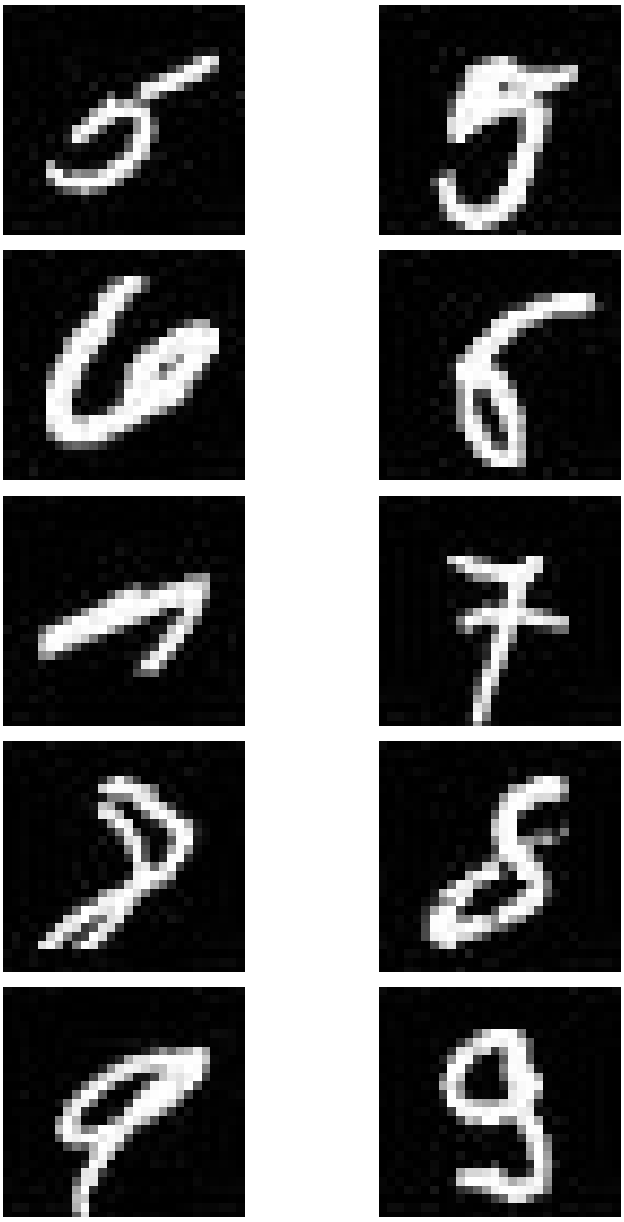
A.

1. High number of hidden layers leads to overfitting. And having very less hidden layers can cause under fitting.
2. Same is the case with number of neurons.
3. Best accuracy is obtained at no. of layers = 2 and number of neurons = 50.
4. Time taken increases with increase either the layers or neurons.
5. Changing activation function has no much effect on accuracy and time taken.

III. Misclassified Images Of Digits

Given below are some of the misclassified images of each digit in increasing order.





The images are highly distorted therefore they are misclassified.

IV. Comparision with DCT features

Adding an extra layer to DCT features does not give any additional benefit. Because the features are already the best representatives of each digits used for classification.

V. Convolutional Neural Network

Using convolutional neural network for the given data:

Hidden Layers	test accuracy	training accuracy	Time taken
0	97.3%	98.2%	9 s
1	95.8%	98.6%	15 s
2	91.0%	98.5%	18 s

For the data from http://yann.lecun.com/exdb/mnist/ Convolutional net LeNet-1

Convolutional Neural networks are very much accurate. They can result in accuracies of more than 99% within 2 layers.

Hidden Layers	test accuracy	training accuracy
0	98.5%	99.1%
1	98.9%	99.7%
2	99.4%	99.4%

Hidden Layers	test accuracy	training accuracy
0	96.5%	97.2%
1	98.3%	98.8%
2	99.7%	99.5%