EEL709: Assignment 3

Neural Networks for a multiclass classification

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# Neural Networks

## 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 |

## 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 |

## Changing Activation function

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

# Interpretation

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.

# 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.

# 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.

|  |  |  |  |
| --- | --- | --- | --- |
| **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 |

# Convolutional Neural Network

Using convolutional neural network for the given data:

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

|  |  |  |
| --- | --- | --- |
| **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% |

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