1. Fifth, write up a summary report describing what your neural network was able to do and what experiments you ran. Assume the reader is familiar with machine learning and neural network terminology at the level we've covered in class.

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Neural Network Summary Report

Methodology:

For my Neural Network project, I chose to write my program using the Neuron object method, where hidden neurons are considered neurons, and output neurons are an extension of neurons which has a category field. Neurons contain an array of weights, which include the bias, as well as weights for each of its inputs (which is either sensor inputs or hidden neurons). Something to note for these neurons is they have no fields to connect them with each other. To “fire” the neurons the function “getOutput()” is used.

Most of the code to run the Neural Net is done in the NeuralNet class (which is made into an object). This uses all of the functions that were laid out on haiku. The Neural Net contains a learning rate, and arrays of hidden and output Neurons.

When reading in data, all of the data is read into a list of Examples. The Example class contains a category, stored as an int, as well as an array of attributes, stored as doubles. The array of doubles is used as the inputs when running the neural net, and the

Results:

My Neural Net was able to successfully train and achieve good accuracy for the AND, XOR, digits, and MNIST digits data groups.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Data Group | Hidden Neurons | Learning Rate | Validation Percent | Number of Epochs | Training Accuracy | Testing Accuracy |
| AND | 2 | 10 | NA | 29 | 100% | 100% |
| XOR | 2 | 0.05 | NA | 26000 | 100% | 100% |
| Digits | 128 | 0.03 | 0.1 | 21 | 98.69% | 96.27% |
| MNIST | 256 | 0.01 | 0.2 | 64 | 97.5% | 97.28% |

Overall, these results seem quite normal compared to the results of my classmates.

Experimentation:

Changing initial values of the weights:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Data Group | Hidden Neurons | Learning Rate | Number of Epochs for Starting Weights between +-0.05 | Number of Epochs for Starting Weights at 0.05 | Number of Epochs for Starting Weights between +-1.0 | Number of Epochs for Starting Weights all at 1.0 |
| AND | 2 | 10 | 29 |  | 27 | 45 |
| XOR | 2 | 0.05 | 26,000 |  | ~10,000 (Works about 75% of the time) | Doesn’t work |
| Digits (to 97% training) | 128 | 0.03 | 2 |  | 62 | Doesn’t work (162 epochs attempted but no improvement inaccuracy was made |

Clearly it seems to be better that the small weights seem to work the best