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Perceptron/Neural Networks Laboratory

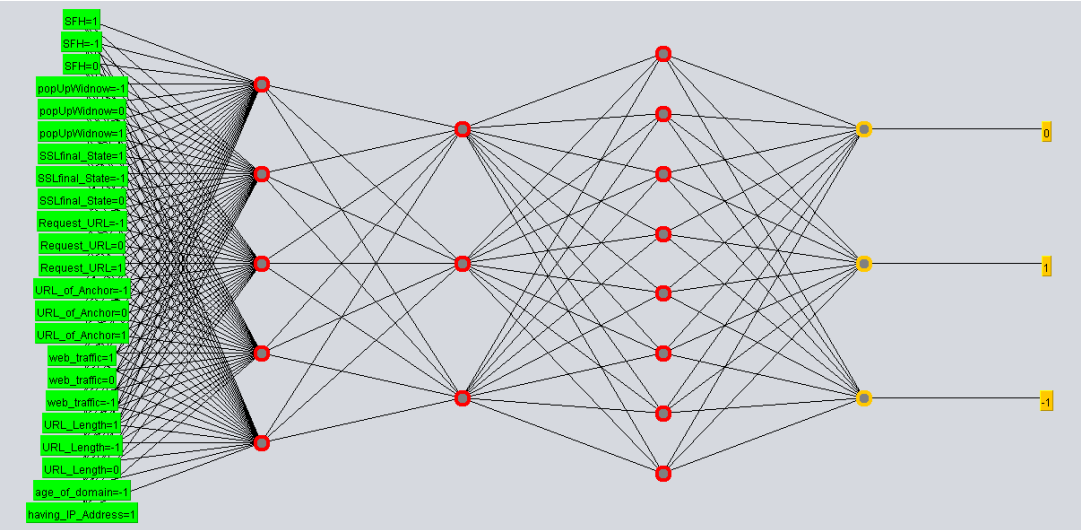
Linearly separable example scatter plot

This plot proves that the data given is effectively linearly separable, thus a perceptron (neural network of one hidden layer and one output) can separate data and give solutions for given inputs.

Artificial Neural Networks Analysis with Weka

The set of data used for this analysis is called Phishing data. It is compound of 10 attributes (inputs) and 1353 instances.

Neural Network One



Learning rate = 0.3
Momentum = 0.2
Epochs = 500

Data used for training

In 500 epochs (iterations) the error per epoch decreased to 0.039
Correctly classified instances = 93.34%
Incorrectly classified instances = 6.65%
Time taken to test model on training data: 0.03 seconds

50% of data for training and 50% for testing

For testing:
In 500 epochs (iterations) the error per epoch decreased to 0.041
Correctly classified instances = 85.79%
Incorrectly classified instances = 14.20%
Time taken to test model on test split: 0.01 seconds

Conclusion: The amount of training data is little to expect a result near to 99.99% of correct instances classified when testing.

Changing learning rate = 0.8

Data used for training

In 500 epochs (iterations) the error per epoch decreased to 0.041

Correctly classified instances = 92.23%
Incorrectly classified instances = 7.76%
Time taken to test model on training data = 0.01 seconds

50% of data for training and 50% for testing

For testing:
In 500 epochs (iterations) the error per epoch decreased to 0.044
Correctly classified instances = 86.53%
Incorrectly classified instances = 13.46%
Time taken to test model on test split: 0.01 seconds

Conclusion: Have increased learning rate helped to reduce error (incorrectly classified instances) when testing. Time taken for training decreased from last prove, this must mean that for a higher learning rate the training algorithm (forward and backward propagation) is less "strict".

Changing epochs = 1000 (from original NN parameters)

Data used for training

In 500 epochs (iterations) the error per epoch decreased to 0.038
Correctly classified instances = 93.05%
Incorrectly classified instances = 6.94%
Time taken to test model on training data: 0.02 seconds

50% of data for training and 50% for testing

For testing:
In 500 epochs (iterations) the error per epoch decreased to 0.040
Correctly classified instances = 85.94%
Incorrectly classified instances = 14.05%
Time taken to test model on test split: 0.02 seconds

Conclusion: Have increased epochs decreased very little error. Time taken for testing doubled, as the epochs (this is a very expected time result).

20% of data for training and 80% for testing (from original NN)

For testing:
In 500 epochs (iterations) the error per epoch decreased to 0.026
Correctly classified instances = 82.99%
Incorrectly classified instances = 17.00%
Time taken to test model on test split: 0.02 seconds

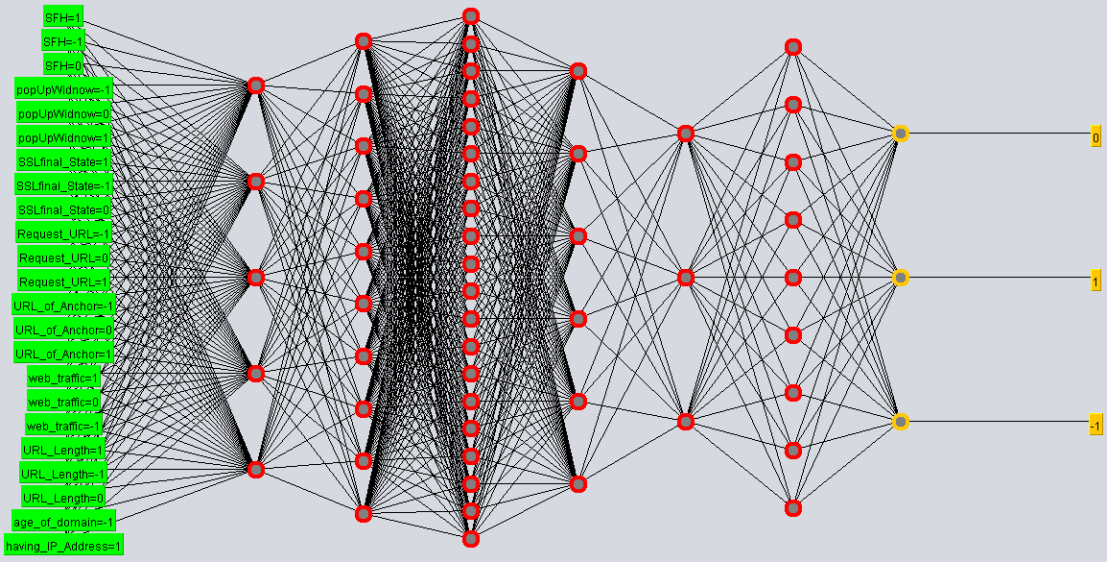
Conclusion: As expected, error increased compared to when it is 50% training and 50% testing, because NN had less data to learn. That was a behavior we have seen since we reduced 100% training to 50% training and 50% testing, that is why this was expected. Considering the % of data for testing from 50 to 80, the time taken doubled from 0.01 to 0.02. An expected result, just because more data was used for testing.

80% of data for training and 20% for testing (from original NN)

For testing:
In 500 epochs (iterations) the error per epoch decreased to 0.041
Correctly classified instances = 87.82%
Incorrectly classified instances = 12.17%
Time take to test model on test split: 0.01seconds

Conclusion: Error decreased a little compared to when It is 50%/50%. This is a very good NN because neither in the 20%/80% nor in the 80%/20%, it went overfitted.

Neural Network Two



Learning rate = 0.3
Momentum = 0.2
Epochs = 500

Time taken to test model on training data (100% of data for training): 0.07 seconds

90% of data for training and 10% for testing

For testing:
Correctly classified instances = 54.81%
Incorrectly classified instances = 45.18%
Time taken to test model on test split: 0.01 seconds

Conclusion: Obviously this NN is being overfitted. Too much data for training, so when it is tested, results are wrong. In this case almost 50% correct and 50% wrong. Time taken is very little because it was used just 10% of the data. Even for this complex NN, using 10% of data for testing is fast = 0.01 seconds. On the other hand, when using 100% of data for training, time increase from 0.03 to 0.07 seconds between the less complex and the more complex NN, same parameters, different NN.