

Summary: training a machine learning algorithm with walking and rotation data, solved as a pattern-recognition problem using a two-layer feed-forward network.

Intro

In pattern recognition problems, you want a neural network to classify inputs into a set of target categories. Neural pattern recognition creates and trains a network of data, and evaluate its performance using cross-entropy and confusion matrices. Minimizing Cross-Entropy results in good classification. A confusion matrix indicates the fraction of samples which are misclassified.

A two-layer feed-forward network, with sigmoid hidden and softmax output neurons, can classify vectors arbitrarily well, given enough neurons in its hidden layer. The network is trained with scaled conjugate gradient backpropagation.

The measurements for each subject included: maximum values, minimum values, range values, imbalance values, time (%) of max value, time (%) of min value. These features were computed for the segments that displayed a significant difference between LBP and NLBP subjects.

75% of the samples were used for training: they are presented to the network during training, and the network is adjusted according to its error. 20% were used as validation samples: used to measure network generalization, and to halt training when generalization stops improving. 5% of the samples have no effect on training and were used to provide an independent measure of network performance during and after training. Different numbers of hidden neurons were experimented with, but typically 40-50 hidden neurons provided increased accuracy.

A typical test for data: Input is a 15x222 matrix, representing static data: 222 samples of 15 features. Target is a 2x222 matrix, representing static data: 222 samples of 2 targets (LBP vs NLBP).

All of the trials are in the Excel document attached.

Walking Data Testing (Appendix 1)

First set of samples tested was walking data. The segments that were analyzed were LLPelvisZ, LTULZ, and UTLTX for 60 subjects (X is frontal plane, Z is axial plane). Initially the algorithm was run with 27 features (left- and right-side measurements for each of the three segments) for 60 subjects. Summary of all tests ran for walking data:

Test 1:

9 attributes for each segment (imbalance, t_maxL, t_maxR, t_minL, t_minR, maxL, maxR, rangeL, rangeR), creating a 27x60 input matrix (target was always a 2x60 matrix). Trained algorithm typically gave 68% accuracy.

Test 2:

7 attributes for each (imbalance, t_maxL, t_maxR, t_minL, t_minR, maxR, rangeR), creating a 21x60 input matrix. Trained algorithm typically gave 71% accuracy.

Test 3:

5 attributes for each (imbalance, t_maxL, t_maxR, t_minL, t_minR), creating a 15x60 input matrix. Trained algorithm typically gave 64% accuracy.

Test 4:

5 attributes for each (imbalance, t_maxR, t_minR, maxR, rangeR), taking out UTLTX t_maxR due to perceived irrelevance, creating a 14x60 input matrix. Trained algorithm typically gave 65% accuracy.

Test 5:

7 attributes for each (imbalance, t_maxL, t_maxR, t_minL, t_minR, maxR, rangeR), taking out UTLTX t_max, LTULZ t_min due to perceived irrelevance, creating a 17x60 input matrix. Trained algorithm typically gave 64% accuracy.

Test 6:

7 attributes for each (imbalance, t_maxL, t_maxR, t_minL, t_minR, maxR, rangeR), taking out UTLTX t_max due to perceived irrelevance, creating a 19x60 input matrix. Trained algorithm typically gave 68% accuracy.

Test 2, re-tested:

Trained algorithm with 21 features typically gave 70% accuracy, this was perceived as the best combination for accurate results.

Rotation Data Testing (Appendix 2)

Second set of samples tested was rotation data. There were 232 subjects due to almost 60 subjects each treated separately for their data in standing left, standing right, sitting left, and sitting right rotations. The segments that were analyzed were LLPelvisX, LTLLX, UTLLX (X is frontal plane). Only one combination of 15 features was used: 5 attributes for each segment (imbalance, t_max, t_min, max, range), creating a 15x232 input matrix (target was always a 2x232 matrix). Trained algorithm typically gave 73% accuracy.

Manual Testing of Rotation Data (Appendix 3)

After determining higher perceived accuracy of rotation data over walking data, manual testing of 10 selected subjects using the trained algorithm was conducted. These 10 subjects were omitted from training (222 samples were part of the training algorithm).

The results of the first and second test are in the Excel file, with three different trained algorithms used for manually testing for each test.

Test 1 pulled out samples 223 to 232. The three different trained algorithms are described as follows:

Function 1:

A trained network using 40 hidden neurons. 167 samples trained with 13.7% error, 44 samples validated with 22.7% error, 11 samples independently tested with 18.2% error. 10 selected subjects were then manually tested with results in the Excel file.

Function 2:

A trained network using 40 hidden neurons. 167 samples trained with 4.8% error, 44 samples validated with 20.5% error, 11 samples independently tested with 45.5% error. 10 selected subjects were then manually tested with results in the Excel file.

Function 3:

A trained network using 40 hidden neurons. 167 samples trained with 18% error, 44 samples validated with 25% error, 11 samples independently tested with 18.2% error. 10 selected subjects were then manually tested with results in the Excel file.

Test 2 pulled out samples 211 to 220. The three different trained algorithms are described as follows:

Function 1:

A trained network using 40 hidden neurons. 167 samples trained with 10.8% error, 44 samples validated with 22.7% error, 11 samples independently tested with 9.1% error. 10 selected subjects were then manually tested with results in the Excel file.

Function 2:

A trained network using 40 hidden neurons. 167 samples trained with 9.0% error, 44 samples validated with 15.9% error, 11 samples independently tested with 54.5% error. 10 selected subjects were then manually tested with results in the Excel file.

Function 3:

A trained network using 40 hidden neurons. 167 samples trained with 13.7% error, 44 samples validated with 22.7% error, 11 samples independently tested with 9.1% error. 10 selected subjects were then manually tested with results in the Excel file.

Appendix 1: Walking Data Test Results (Test 1 is not displayed but is in the Excel file)

| Features (Fixed) | 21 | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hidden Neurons | 15 | | | 21 | | | 25 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 71.66 | 71.26 | 71.57 | 69.45 | 63.34 | 68.16 | 75.34 | 73.75 | 75.00 | 70.46 | 68.75 | 70.10 | 71.10 | 66.25 | 70.08 | 75.88 | 63.34 | 73.24 |
| St. Dev. | 15.7 | 10.6 | 13.44 | 12.1 | 14.7 | 10.5 | 13.4 | 13.6 | 10.5 | 13.3 | 9.71 | 11 | 15.2 | 11.3 | 12.6 | 14.6 | 15.4 | 12.5 |
| Test 2 | 64.4 | 66.7 | 64.88 | 46.7 | 50 | 47.39 | 73.3 | 75 | 73.66 | 73.3 | 75 | 73.66 | 82.2 | 83.3 | 82.43 | 88.9 | 66.7 | 84.23 |
| | 71.1 | 58.3 | 68.41 | 82.2 | 66.7 | 78.94 | 46.7 | 83.3 | 54.41 | 73.3 | 75 | 73.66 | 66.7 | 58.3 | 64.93 | 73.3 | 66.7 | 71.91 |
| | 73.3 | 50 | 68.39 | 84.4 | 66.7 | 80.67 | 91.1 | 83.3 | 89.46 | 80 | 75 | 78.95 | 93.3 | 58.3 | 85.93 | 91.1 | 50 | 82.45 |
| | 84.4 | 66.7 | 80.67 | 77.8 | 75 | 77.21 | 66.7 | 83.3 | 70.19 | 44.4 | 66.7 | 49.09 | 55.6 | 66.7 | 57.94 | 82.2 | 75 | 80.68 |
| | 84.4 | 75 | 82.42 | 75.6 | 66.7 | 73.73 | 86.7 | 75 | 84.24 | 91.1 | 75 | 87.71 | 55.3 | 58.3 | 55.93 | 93.3 | 83.3 | 91.19 |
| | 97.8 | 83.3 | 94.75 | 77.8 | 75 | 77.21 | 82.2 | 75 | 80.68 | 73.3 | 75 | 73.66 | 71.1 | 83.3 | 73.67 | 82.2 | 58.3 | 77.17 |
| | 64.4 | 66.7 | 64.88 | 64.4 | 33.3 | 57.85 | 84.4 | 83.3 | 84.17 | 86.7 | 91.7 | 87.75 | 86.7 | 83.3 | 85.98 | 53.3 | 66.7 | 56.12 |
| | 55.6 | 66.7 | 57.94 | 77.8 | 75 | 77.21 | 80 | 91.7 | 82.46 | 86.7 | 50 | 78.97 | 95.6 | 75 | 91.26 | 91.1 | 50 | 82.45 |
| | 71.1 | 66.7 | 70.17 | 44.4 | 83.3 | 52.59 | 82.2 | 75 | 80.68 | 71.1 | 66.7 | 70.17 | 77.8 | 58.3 | 73.69 | 73.3 | 50 | 68.39 |
| | 62.2 | 66.7 | 63.15 | 88.9 | 66.7 | 84.23 | 93.3 | 83.3 | 91.19 | 66.7 | 66.7 | 66.70 | 66.7 | 41.7 | 61.44 | 60 | 75 | 63.16 |
| | 82.2 | 75 | 80.68 | 75.6 | 75 | 75.47 | 86.7 | 66.7 | 82.49 | 51.1 | 58.3 | 52.62 | 82.2 | 66.7 | 78.94 | 82.2 | 66.7 | 78.94 |
| | 66.7 | 83.3 | 70.19 | 55.6 | 58.3 | 56.17 | 88.9 | 66.7 | 84.23 | 80 | 58.3 | 75.43 | 66.7 | 50 | 63.18 | 35.6 | 58.3 | 40.38 |
| | 44.4 | 75 | 50.84 | 57.8 | 66.7 | 59.67 | 68.9 | 75 | 70.18 | 68.9 | 75 | 70.18 | 53.3 | 66.7 | 56.12 | 73.3 | 75 | 73.66 |
| | 93.3 | 91.7 | 92.96 | 66.7 | 66.7 | 66.70 | 66.7 | 66.7 | 66.70 | 55.6 | 75 | 59.68 | 60 | 83.3 | 64.91 | 77.8 | 58.3 | 73.69 |
| | 71.1 | 75 | 71.92 | 73.3 | 66.7 | 71.91 | 71.1 | 66.7 | 70.17 | 55.8 | 58.3 | 56.33 | 80 | 66.7 | 77.20 | 95.6 | 100 | 96.53 |
| | 37.8 | 58.3 | 42.12 | 64.4 | 33.3 | 57.85 | 80 | 75 | 78.95 | 60 | 58.3 | 59.64 | 44.4 | 66.7 | 49.09 | 77.8 | 33.3 | 68.43 |
| | 88.9 | 66.7 | 84.23 | 75.6 | 66.7 | 73.73 | 55.6 | 75 | 59.68 | 80 | 58.3 | 75.43 | 64.4 | 66.7 | 64.88 | 73.3 | 75 | 73.66 |
| | 88.9 | 75 | 85.97 | 57.8 | 75 | 61.42 | 82.2 | 33.3 | 71.91 | 86.7 | 66.7 | 82.49 | 51.1 | 66.7 | 54.38 | 68.9 | 41.7 | 63.17 |
| | 71.1 | 91.7 | 75.44 | 71.1 | 33.3 | 63.14 | 48.9 | 91.7 | 57.91 | 68.9 | 75 | 70.18 | 75.6 | 58.3 | 71.96 | 80 | 50 | 73.68 |
| | 60 | 66.7 | 61.41 | 71.1 | 66.7 | 70.17 | 71.1 | 50 | 66.66 | 55.6 | 75 | 59.68 | 93.3 | 66.7 | 87.70 | 64.4 | 66.7 | 64.88 |

| Features (Fixed) | 15 | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|------|----|----|------|-------|-------|-------|
| Hidden Neurons | 10 | | | 15 | | | 20 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 66.12 | 63.34 | 65.53 | 66.00 | 62.09 | 65.17 | 64.45 | 59.58 | 63.42 | | | 0.00 | | | 0.00 | 65.56 | 62.09 | 64.83 |
| St. Dev. | 10.5 | 15.6 | 8.251 | 7.75 | 17.6 | 6.38 | 12 | 16.7 | 11 | | | 0 | | | 0 | 13.8 | 16.8 | 10.5 |
| | 68.9 | 91.7 | 73.70 | 62.2 | 41.7 | 57.88 | 57.8 | 66.7 | 59.67 | | | 0.00 | | | 0.00 | 48.9 | 66.7 | 52.65 |
| | 75.6 | 58.3 | 71.96 | 73.3 | 83.3 | 75.41 | 75.6 | 75 | 75.47 | | | 0.00 | | | 0.00 | 77.8 | 50 | 71.95 |
| Test 3 | 48.9 | 75 | 54.39 | 71.1 | 41.7 | 64.91 | 66.7 | 75 | 68.45 | | | 0.00 | | | 0.00 | 71.1 | 75 | 71.92 |
| | 77.8 | 33.3 | 68.43 | 77.8 | 58.3 | 73.69 | 66.7 | 50 | 63.18 | | | 0.00 | | | 0.00 | 51.1 | 66.7 | 54.38 |
| | 80 | 66.7 | 77.20 | 75.6 | 58.3 | 71.96 | 51.1 | 50 | 50.87 | | | 0.00 | | | 0.00 | 71.1 | 83.3 | 73.67 |
| | 48.9 | 83.3 | 56.14 | 68.9 | 83.3 | 71.93 | 73.3 | 66.7 | 71.91 | | | 0.00 | | | 0.00 | 55.6 | 66.7 | 57.94 |
| | 77.8 | 50 | 71.95 | 66.7 | 58.3 | 64.93 | 53.3 | 50 | 52.61 | | | 0.00 | | | 0.00 | 44.4 | 66.7 | 49.09 |
| | 64.4 | 41.7 | 59.62 | 66.7 | 33.3 | 59.67 | 44.4 | 58.3 | 47.33 | | | 0.00 | | | 0.00 | 62.2 | 91.7 | 68.41 |
| | 73.3 | 66.7 | 71.91 | 53.3 | 66.7 | 56.12 | 62.2 | 25 | 54.37 | | | 0.00 | | | 0.00 | 68.9 | 75 | 70.18 |
| | 55.6 | 50 | 54.42 | 66.7 | 91.7 | 71.96 | 80 | 91.7 | 82.46 | | | 0.00 | | | 0.00 | 71.1 | 25 | 61.39 |
| | 55.6 | 58.3 | 56.17 | 68.9 | 66.7 | 68.44 | 71.1 | 58.3 | 68.41 | | | 0.00 | | | 0.00 | 75.6 | 58.3 | 71.96 |
| | 73.3 | 91.7 | 77.17 | 53.3 | 83.3 | 59.62 | 68.9 | 33.3 | 61.41 | | | 0.00 | | | 0.00 | 84.4 | 58.3 | 78.91 |
| | 62.2 | 66.7 | 63.15 | 73.3 | 66.7 | 71.91 | 37.8 | 50 | 40.37 | | | 0.00 | | | 0.00 | 40 | 66.7 | 45.62 |
| | 75.6 | 75 | 75.47 | 62.2 | 41.7 | 57.88 | 57.8 | 58.3 | 57.91 | | | 0.00 | | | 0.00 | 51.1 | 66.7 | 54.38 |
| | 82.2 | 50 | 75.42 | 68.9 | 41.7 | 63.17 | 68.9 | 75 | 70.18 | | | 0.00 | | | 0.00 | 75.6 | 33.3 | 66.69 |
| | 60 | 50 | 57.89 | 53.3 | 58.3 | 54.35 | 57.8 | 75 | 61.42 | | | 0.00 | | | 0.00 | 80 | 58.3 | 75.43 |
| | 68.9 | 58.3 | 66.67 | 73.3 | 50 | 68.39 | 60 | 58.3 | 59.64 | | | 0.00 | | | 0.00 | 66.7 | 75 | 68.45 |
| | 60 | 58.3 | 59.64 | 53.3 | 91.7 | 61.38 | 80 | 33.3 | 70.17 | | | 0.00 | | | 0.00 | 53.3 | 41.7 | 50.86 |
| | 55.6 | 75 | 59.68 | 62.2 | 66.7 | 63.15 | 73.3 | 75 | 73.66 | | | 0.00 | | | 0.00 | 75.6 | 75 | 75.47 |
| | 57.8 | 66.7 | 59.67 | 68.9 | 58.3 | 66.67 | 82.2 | 66.7 | 78.94 | | | 0.00 | | | 0.00 | 86.7 | 41.7 | 77.23 |

| Features (Fixed) | 14 (Right side + imbalance - UTLTX t_max) | | | | | | | | | | | | | | | | | |
|------------------|---|-------|-------|-------|-------|-------|----|----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hidden Neurons | 10 | | | 15 | | | 20 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 66.55 | 63.34 | 65.87 | 62.56 | 62.09 | 62.46 | | | 0.00 | 65.45 | 60.01 | 64.30 | 68.23 | 64.17 | 67.37 | 71.66 | 60.01 | 69.21 |
| St. Dev. | 9.37 | 16.1 | 7.48 | 11.7 | 11 | 9.22 | | | 0 | 13.2 | 10.7 | 11.1 | 13.8 | 16.7 | 10.8 | 13.8 | 14.5 | 11.3 |
| Test 4 | 77.8 | 33.3 | 68.43 | 68.9 | 83.3 | 71.93 | | | 0.00 | 75.6 | 66.7 | 73.73 | 75.6 | 66.7 | 73.73 | 88.9 | 66.7 | 84.23 |
| | 53.3 | 91.7 | 61.38 | 57.8 | 83.3 | 63.17 | | | 0.00 | 57.8 | 75 | 61.42 | 64.4 | 58.3 | 63.12 | 75.6 | 58.3 | 71.96 |
| | 71.1 | 66.7 | 70.17 | 75.6 | 50 | 70.21 | | | 0.00 | 46.7 | 41.7 | 45.65 | 40 | 58.3 | 43.85 | 57.8 | 58.3 | 57.91 |
| | 57.8 | 75 | 61.42 | 46.7 | 41.7 | 45.65 | | | 0.00 | 46.7 | 58.3 | 49.14 | 48.9 | 75 | 54.39 | 91.1 | 66.7 | 85.96 |
| | 62.2 | 50 | 59.63 | 68.9 | 58.3 | 66.67 | | | 0.00 | 75.6 | 66.7 | 73.73 | 77.8 | 41.7 | 70.20 | 64.4 | 66.7 | 64.88 |
| | 77.8 | 75 | 77.21 | 60 | 50 | 57.89 | | | 0.00 | 68.9 | 58.3 | 66.67 | 84.4 | 91.7 | 85.94 | 84.4 | 33.3 | 73.64 |
| | 73.3 | 50 | 68.39 | 57.8 | 66.7 | 59.67 | | | 0.00 | 68.9 | 66.7 | 68.44 | 75.6 | 66.7 | 73.73 | 80 | 25 | 68.42 |
| | 64.4 | 83.3 | 68.38 | 44.4 | 66.7 | 49.09 | | | 0.00 | 73.3 | 66.7 | 71.91 | 71.1 | 33.3 | 63.14 | 71.1 | 66.7 | 70.17 |
| | 73.3 | 58.3 | 70.14 | 73.3 | 66.7 | 71.91 | | | 0.00 | 91.1 | 75 | 87.71 | 80 | 75 | 78.95 | 53.3 | 66.7 | 56.12 |
| | 73.3 | 66.7 | 71.91 | 75.6 | 50 | 70.21 | | | 0.00 | 77.8 | 50 | 71.95 | 55.6 | 75 | 59.68 | 57.8 | 41.7 | 54.41 |
| | 53.3 | 66.7 | 56.12 | 33.3 | 66.7 | 40.33 | | | 0.00 | 48.9 | 66.7 | 52.65 | 46.7 | 58.3 | 49.14 | 68.9 | 41.7 | 63.17 |
| | 64.4 | 83.3 | 68.38 | 55.6 | 66.7 | 57.94 | | | 0.00 | 73.3 | 58.3 | 70.14 | 77.8 | 66.7 | 75.46 | 64.4 | 66.7 | 64.88 |
| | 68.9 | 75 | 70.18 | 55.6 | 58.3 | 56.17 | | | 0.00 | 62.2 | 33.3 | 56.12 | 80 | 41.7 | 71.94 | 100 | 75 | 94.74 |
| | 48.9 | 50 | 49.13 | 71.1 | 58.3 | 68.41 | | | 0.00 | 71.1 | 66.7 | 70.17 | 44.4 | 91.7 | 54.36 | 44.4 | 66.7 | 49.09 |
| | 71.1 | 33.3 | 63.14 | 68.9 | 75 | 70.18 | | | 0.00 | 71.1 | 50 | 66.66 | 68.9 | 50 | 64.92 | 77.8 | 75 | 77.21 |
| | 62.2 | 50 | 59.63 | 64.4 | 58.3 | 63.12 | | | 0.00 | 73.3 | 50 | 68.39 | 77.8 | 75 | 77.21 | 64.4 | 66.7 | 64.88 |
| | 53.3 | 66.7 | 56.12 | 62.2 | 66.7 | 63.15 | | | 0.00 | 44.4 | 66.7 | 49.09 | 75.6 | 58.3 | 71.96 | 64.4 | 50 | 61.37 |
| | 80 | 66.7 | 77.20 | 60 | 66.7 | 61.41 | | | 0.00 | 48.9 | 58.3 | 50.88 | 73.3 | 50 | 68.39 | 75.6 | 75 | 75.47 |
| | 75.6 | 75 | 75.47 | 73.3 | 50 | 68.39 | | | 0.00 | 55.6 | 58.3 | 56.17 | 64.4 | 91.7 | 70.15 | 82.2 | 58.3 | 77.17 |
| | 68.9 | 50 | 64.92 | 77.8 | 58.3 | 73.69 | | | 0.00 | 77.8 | 66.7 | 75.46 | 82.2 | 58.3 | 77.17 | 66.7 | 75 | 68.45 |

| | | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|------|-------|-------|-------|----|----|------|
| Features (Fixed) | 17 | | | | | | | | | | | | | | | | | |
| Hidden Neurons | 15 | | | 20 | | | 25 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 64.78 | 58.33 | 63.42 | 66.56 | 62.09 | 65.62 | 69.56 | 57.09 | 66.93 | | | 0.00 | 65.12 | 56.25 | 63.25 | | | 0.00 |
| St. Dev. | 12.9 | 14.8 | 10.73 | 11.7 | 19.6 | 8.32 | 13.5 | 15.1 | 10.3 | | | 0 | 13.7 | 14.5 | 10.3 | | | 0 |
| Test 5 | 82.2 | 58.3 | 77.17 | 64.4 | 41.7 | 59.62 | 77.8 | 75 | 77.21 | | | 0.00 | 77.8 | 58.3 | 73.69 | | | 0.00 |
| | 80 | 91.7 | 82.46 | 46.7 | 75 | 52.66 | 75.6 | 58.3 | 71.96 | | | 0.00 | 77.8 | 66.7 | 75.46 | | | 0.00 |
| | 37.8 | 50 | 40.37 | 66.7 | 83.3 | 70.19 | 66.7 | 41.7 | 61.44 | | | 0.00 | 68.9 | 33.3 | 61.41 | | | 0.00 |
| | 66.7 | 75 | 68.45 | 48.9 | 100 | 59.66 | 82.2 | 41.7 | 73.67 | | | 0.00 | 62.2 | 33.3 | 56.12 | | | 0.00 |
| | 66.7 | 41.7 | 61.44 | 77.8 | 75 | 77.21 | 73.3 | 75 | 73.66 | | | 0.00 | 60 | 58.3 | 59.64 | | | 0.00 |
| | 86.7 | 58.3 | 80.72 | 66.7 | 41.7 | 61.44 | 75.6 | 41.7 | 68.46 | | | 0.00 | 46.7 | 33.3 | 43.88 | | | 0.00 |
| | 73.3 | 58.3 | 70.14 | 71.1 | 50 | 66.66 | 80 | 41.7 | 71.94 | | | 0.00 | 51.1 | 66.7 | 54.38 | | | 0.00 |
| | 64.4 | 58.3 | 63.12 | 42.2 | 100 | 54.37 | 80 | 41.7 | 71.94 | | | 0.00 | 57.8 | 66.7 | 59.67 | | | 0.00 |
| | 62.2 | 50 | 59.63 | 86.7 | 58.3 | 80.72 | 66.7 | 83.3 | 70.19 | | | 0.00 | 71.1 | 66.7 | 70.17 | | | 0.00 |
| | 60 | 75 | 63.16 | 64.4 | 66.7 | 64.88 | 68.9 | 58.3 | 66.67 | | | 0.00 | 75.6 | 58.3 | 71.96 | | | 0.00 |
| | 60 | 58.3 | 59.64 | 71.1 | 50 | 66.66 | 53.3 | 75 | 57.87 | | | 0.00 | 75.6 | 50 | 70.21 | | | 0.00 |
| | 73.3 | 41.7 | 66.65 | 62.2 | 33.3 | 56.12 | 86.7 | 41.7 | 77.23 | | | 0.00 | 44.4 | 58.3 | 47.33 | | | 0.00 |
| | 57.8 | 58.3 | 57.91 | 60 | 75 | 63.16 | 37.8 | 50 | 40.37 | | | 0.00 | 46.7 | 75 | 52.66 | | | 0.00 |
| | 42.2 | 75 | 49.11 | 62.2 | 75 | 64.89 | 64.4 | 58.3 | 63.12 | | | 0.00 | 84.4 | 41.7 | 75.41 | | | 0.00 |
| | 46.7 | 41.7 | 45.65 | 77.8 | 66.7 | 75.46 | 37.8 | 75 | 45.63 | | | 0.00 | 80 | 33.3 | 70.17 | | | 0.00 |
| | 68.9 | 58.3 | 66.67 | 77.8 | 41.7 | 70.20 | 82.2 | 83.3 | 82.43 | | | 0.00 | 66.7 | 58.3 | 64.93 | | | 0.00 |
| | 73.3 | 66.7 | 71.91 | 60 | 41.7 | 56.15 | 71.1 | 50 | 66.66 | | | 0.00 | 48.9 | 75 | 54.39 | | | 0.00 |
| | 64.4 | 41.7 | 59.62 | 68.9 | 41.7 | 63.17 | 66.7 | 50 | 63.18 | | | 0.00 | 73.3 | 75 | 73.66 | | | 0.00 |
| | 75.6 | 33.3 | 66.69 | 84.4 | 66.7 | 80.67 | 80 | 50 | 73.68 | | | 0.00 | 84.4 | 50 | 77.16 | | | 0.00 |
| | 53.3 | 75 | 57.87 | 71.1 | 58.3 | 68.41 | 64.4 | 50 | 61.37 | | | 0.00 | 48.9 | 66.7 | 52.65 | | | 0.00 |

| Features (Fixed) | 19 | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hidden Neurons | 19 | | | 20 | | | 25 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | 71.5 | 45 | | 68.1 | 45 | | 75 | 45 | | 70 | 45 | | 70 | 45 | | 73 |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 66.89 | 56.66 | 64.74 | 69.45 | 56.67 | 66.76 | 65.67 | 59.59 | 64.39 | 64.22 | 64.17 | 64.21 | 70.44 | 63.33 | 68.94 | 80.67 | 68.34 | 78.07 |
| St. Dev. | 11.8 | 12 | 10.03 | 13.3 | 13.1 | 12.1 | 12.7 | 16.9 | 10.3 | 15.1 | 14.6 | 12.1 | 14.1 | 11.3 | 12.3 | 12.7 | 13.7 | 10.3 |
| | 55.6 | 66.7 | 57.94 | 60 | 41.7 | 56.15 | 68.9 | 33.3 | 61.41 | 46.7 | 75 | 52.66 | 62.2 | 58.3 | 61.38 | 64.4 | 75 | 66.63 |
| | 51.1 | 75 | 56.13 | 86.7 | 58.3 | 80.72 | 75.6 | 33.3 | 66.69 | 62.2 | 58.3 | 61.38 | 60 | 50 | 57.89 | 88.9 | 83.3 | 87.72 |
| Test 6 | 82.2 | 58.3 | 77.17 | 86.7 | 75 | 84.24 | 51.1 | 41.7 | 49.12 | 82.2 | 41.7 | 73.67 | 68.9 | 33.3 | 61.41 | 75.6 | 58.3 | 71.96 |
| | 60 | 66.7 | 61.41 | 75.6 | 58.3 | 71.96 | 71.1 | 75 | 71.92 | 53.3 | 66.7 | 56.12 | 73.3 | 58.3 | 70.14 | 80 | 75 | 78.95 |
| | 82.2 | 75 | 80.68 | 75.6 | 58.3 | 71.96 | 57.8 | 58.3 | 57.91 | 62.2 | 66.7 | 63.15 | 55.6 | 66.7 | 57.94 | 64.4 | 66.7 | 64.88 |
| | 66.7 | 41.7 | 61.44 | 71.1 | 66.7 | 70.17 | 60 | 66.7 | 61.41 | 62.2 | 91.7 | 68.41 | 68.9 | 66.7 | 68.44 | 53.3 | 58.3 | 54.35 |
| | 60 | 58.3 | 59.64 | 44.4 | 41.7 | 43.83 | 66.7 | 58.3 | 64.93 | 51.1 | 75 | 56.13 | 40 | 58.3 | 43.85 | 86.7 | 91.7 | 87.75 |
| | 77.8 | 58.3 | 73.69 | 75.6 | 66.7 | 73.73 | 71.1 | 41.7 | 64.91 | 62.2 | 41.7 | 57.88 | 64.4 | 58.3 | 63.12 | 97.8 | 75 | 93.00 |
| | 46.7 | 33.3 | 43.88 | 75.6 | 75 | 75.47 | 42.2 | 75 | 49.11 | 42.2 | 66.7 | 47.36 | 77.8 | 58.3 | 73.69 | 93.3 | 66.7 | 87.70 |
| | 44.4 | 58.3 | 47.33 | 62.2 | 41.7 | 57.88 | 88.8 | 83.3 | 87.64 | 71.1 | 33.3 | 63.14 | 80 | 66.7 | 77.20 | 80 | 66.7 | 77.20 |
| | 80 | 66.7 | 77.20 | 60 | 58.3 | 59.64 | 51.1 | 75 | 56.13 | 48.9 | 58.3 | 50.88 | 68.9 | 66.7 | 68.44 | 71.1 | 75 | 71.92 |
| | 71.1 | 41.7 | 64.91 | 46.7 | 50 | 47.39 | 64.4 | 41.7 | 59.62 | 57.8 | 50 | 56.16 | 77.8 | 66.7 | 75.46 | 57.8 | 83.3 | 63.17 |
| | 71.1 | 50 | 66.66 | 80 | 33.3 | 70.17 | 73.3 | 58.3 | 70.14 | 84.4 | 66.7 | 80.67 | 82.2 | 75 | 80.68 | 77.8 | 66.7 | 75.46 |
| | 71.1 | 58.3 | 68.41 | 42.2 | 58.3 | 45.59 | 57.8 | 58.3 | 57.91 | 75.6 | 58.3 | 71.96 | 88.9 | 75 | 85.97 | 91.1 | 50 | 82.45 |
| | 82.2 | 50 | 75.42 | 68.9 | 33.3 | 61.41 | 55.6 | 50 | 54.42 | 53.3 | 58.3 | 54.35 | 53.3 | 75 | 57.87 | 82.2 | 50 | 75.42 |
| | 60 | 58.3 | 59.64 | 64.4 | 50 | 61.37 | 77.8 | 75 | 77.21 | 51.1 | 75 | 56.13 | 51.1 | 50 | 50.87 | 88.9 | 83.3 | 87.72 |
| | 71.1 | 58.3 | 68.41 | 73.3 | 58.3 | 70.14 | 53.3 | 91.7 | 61.38 | 57.8 | 75 | 61.42 | 80 | 75 | 78.95 | 95.6 | 41.7 | 84.25 |
| | 77.8 | 58.3 | 73.69 | 77.8 | 66.7 | 75.46 | 82.2 | 41.7 | 73.67 | 97.8 | 75 | 93.00 | 91.1 | 58.3 | 84.19 | 84.4 | 50 | 77.16 |
| | 60 | 33.3 | 54.38 | 84.4 | 75 | 82.42 | 86.7 | 66.7 | 82.49 | 82.2 | 83.3 | 82.43 | 93.3 | 83.3 | 91.19 | 88.9 | 66.7 | 84.23 |
| | 66.7 | 66.7 | 66.70 | 77.8 | 66.7 | 75.46 | 57.8 | 66.7 | 59.67 | 80 | 66.7 | 77.20 | 71.1 | 66.7 | 70.17 | 91.1 | 83.3 | 89.46 |

| | | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Features (Fixed) | 21 | | | | | | | | | | | | | | | | | |
| Hidden Neurons | 15 | | | 21 | | | 25 | | | 30 | | | 40 | | | 50 | | |
| Training # | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | | 45 | | |
| Validation # | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | | | 12 | |
| Average | 67.22 | 66.66 | 67.10 | 72.11 | 65.83 | 70.79 | 69.01 | 56.25 | 66.32 | 72.33 | 69.17 | 71.66 | 74.00 | 60.01 | 71.05 | 70.77 | 62.92 | 69.12 |
| St. Dev. | 16 | 15 | 14.27 | 11.7 | 14 | 10 | 11.9 | 14.8 | 11.1 | 13 | 15.1 | 10.7 | 10.5 | 16.4 | 8.94 | 16.1 | 12.8 | 13.2 |
| Test 2 Re-test | 62.2 | 58.3 | 61.38 | 68.9 | 58.3 | 66.67 | 82.2 | 75 | 80.68 | 80 | 58.3 | 75.43 | 57.8 | 58.3 | 57.91 | 91.1 | 58.3 | 84.19 |
| | 53.3 | 50 | 52.61 | 75.6 | 75 | 75.47 | 62.2 | 33.3 | 56.12 | 71.1 | 91.7 | 75.44 | 68.9 | 50 | 64.92 | 53.3 | 66.7 | 56.12 |
| | 40 | 58.3 | 43.85 | 82.2 | 50 | 75.42 | 48.9 | 50 | 49.13 | 73.3 | 75 | 73.66 | 75.6 | 25 | 64.95 | 57.8 | 50 | 56.16 |
| | 86.7 | 58.3 | 80.72 | 66.7 | 58.3 | 64.93 | 75.6 | 50 | 70.21 | 84.4 | 50 | 77.16 | 73.3 | 66.7 | 71.91 | 82.2 | 66.7 | 78.94 |
| | 82.2 | 83.3 | 82.43 | 51.1 | 75 | 56.13 | 77.8 | 50 | 71.95 | 53.3 | 50 | 52.61 | 68.9 | 41.7 | 63.17 | 82.2 | 66.7 | 78.94 |
| | 71.1 | 50 | 66.66 | 84.4 | 50 | 77.16 | 60 | 50 | 57.89 | 86.7 | 91.7 | 87.75 | 64.4 | 75 | 66.63 | 93.3 | 75 | 89.45 |
| | 53.3 | 75 | 57.87 | 84.4 | 91.7 | 85.94 | 75.6 | 50 | 70.21 | 91.1 | 66.7 | 85.96 | 77.8 | 33.3 | 68.43 | 71.1 | 50 | 66.66 |
| | 66.7 | 83.3 | 70.19 | 66.7 | 50 | 63.18 | 75.6 | 66.7 | 73.73 | 82.2 | 58.3 | 77.17 | 86.7 | 50 | 78.97 | 82.2 | 83.3 | 82.43 |
| | 55.6 | 83.3 | 61.43 | 86.7 | 91.7 | 87.75 | 55.6 | 41.7 | 52.67 | 71.1 | 66.7 | 70.17 | 73.3 | 75 | 73.66 | 46.7 | 66.7 | 50.91 |
| | 88.9 | 66.7 | 84.23 | 75.6 | 58.3 | 71.96 | 68.9 | 58.3 | 66.67 | 66.7 | 83.3 | 70.19 | 86.7 | 66.7 | 82.49 | 80 | 50 | 73.68 |
| | 51.1 | 50 | 50.87 | 82.2 | 75 | 80.68 | 57.8 | 58.3 | 57.91 | 53.3 | 75 | 57.87 | 82.2 | 50 | 75.42 | 44.4 | 75 | 50.84 |
| | 53.3 | 83.3 | 59.62 | 80 | 75 | 78.95 | 71.1 | 66.7 | 70.17 | 66.7 | 66.7 | 66.70 | 75.6 | 50 | 70.21 | 37.8 | 58.3 | 42.12 |
| | 62.2 | 50 | 59.63 | 73.3 | 75 | 73.66 | 55.6 | 25 | 49.16 | 77.8 | 33.3 | 68.43 | 84.4 | 58.3 | 78.91 | 71.1 | 83.3 | 73.67 |
| | 75.6 | 66.7 | 73.73 | 73.3 | 75 | 73.66 | 73.3 | 41.7 | 66.65 | 73.3 | 75 | 73.66 | 62.2 | 66.7 | 63.15 | 82.2 | 58.3 | 77.17 |
| | 66.7 | 66.7 | 66.70 | 60 | 75 | 63.16 | 55.6 | 58.3 | 56.17 | 66.7 | 66.7 | 66.70 | 80 | 91.7 | 82.46 | 86.7 | 83.3 | 85.98 |
| | 100 | 100 | 100.00 | 53.3 | 75 | 57.87 | 75.6 | 58.3 | 71.96 | 73.3 | 83.3 | 75.41 | 71.1 | 50 | 66.66 | 73.3 | 66.7 | 71.91 |
| | 51.1 | 58.3 | 52.62 | 46.7 | 50 | 47.39 | 53.3 | 75 | 57.87 | 48.9 | 58.3 | 50.88 | 95.6 | 75 | 91.26 | 77.8 | 41.7 | 70.20 |
| | 68.9 | 58.3 | 66.67 | 82.2 | 50 | 75.42 | 84.4 | 83.3 | 84.17 | 91.1 | 66.7 | 85.96 | 53.3 | 66.7 | 56.12 | 73.3 | 58.3 | 70.14 |
| | 91.1 | 83.3 | 89.46 | 77.8 | 50 | 71.95 | 88.9 | 58.3 | 82.46 | 84.4 | 83.3 | 84.17 | 64.4 | 75 | 66.63 | 55.6 | 58.3 | 56.17 |
| | 64.4 | 50 | 61.37 | 71.1 | 58.3 | 68.41 | 82.2 | 75 | 80.68 | 51.1 | 83.3 | 57.88 | 77.8 | 75 | 77.21 | 73.3 | 41.7 | 66.65 |

Appendix 2: Rotation Data Test Results

| Features (Fixed) | 15 | | | | | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hidden Neurons | 15 | | | 20 | | | 25 | | | 30 | | | 40 | | | 50 | | |
| Training # | 174 | | | 174 | | | 174 | | | 174 | | | 174 | | | 174 | | |
| Validation # | | 46 | | | 46 | | | 46 | | | 46 | | | 46 | | | 46 | |
| Average | 71.90 | 66.30 | 70.72 | 73.56 | 69.56 | 72.72 | 75.41 | 68.04 | 73.87 | 73.65 | 69.56 | 72.79 | 77.29 | 70.55 | 75.88 | 75.98 | 67.93 | 74.30 |
| St. Dev. | 4.74 | 6.72 | 4.29 | 6.11 | 6.08 | 4.98 | 6.83 | 8.60 | 5.93 | 5.08 | 8.04 | 4.53 | 5.69 | 7.75 | 5.16 | 5.99 | 7.63 | 5.76 |
| Test 1 | 77.6 | 63.0 | 74.55 | 74.1 | 67.4 | 72.70 | 79.3 | 63.0 | 75.89 | 75.3 | 73.9 | 75.01 | 74.7 | 63.0 | 72.25 | 74.7 | 63.0 | 72.25 |
| | 80.5 | 73.9 | 79.12 | 75.3 | 63.0 | 72.73 | 79.3 | 82.6 | 79.99 | 72.4 | 63.0 | 70.43 | 75.9 | 69.6 | 74.58 | 84.5 | 67.4 | 80.92 |
| | 67.8 | 56.5 | 65.44 | 86.2 | 65.2 | 81.81 | 81.0 | 63.0 | 77.24 | 76.4 | 54.3 | 71.78 | 62.1 | 73.9 | 64.57 | 82.8 | 73.9 | 80.94 |
| | 63.8 | 67.4 | 64.55 | 79.9 | 73.9 | 78.65 | 75.9 | 54.3 | 71.38 | 73.6 | 71.7 | 73.20 | 85.1 | 80.4 | 84.12 | 70.7 | 56.5 | 67.73 |
| | 68.4 | 65.2 | 67.73 | 69.5 | 67.4 | 69.06 | 67.2 | 54.3 | 64.50 | 74.1 | 82.6 | 75.88 | 83.9 | 73.9 | 81.81 | 72.4 | 78.3 | 73.63 |
| | 73.0 | 67.4 | 71.83 | 68.4 | 56.5 | 65.91 | 82.2 | 76.1 | 80.92 | 74.7 | 60.9 | 71.81 | 73.6 | 71.7 | 73.20 | 78.7 | 71.7 | 77.24 |
| | 67.2 | 65.2 | 66.78 | 79.3 | 71.7 | 77.71 | 56.3 | 69.6 | 59.08 | 69.0 | 67.4 | 68.67 | 86.2 | 78.3 | 84.55 | 76.4 | 65.2 | 74.06 |
| | 67.2 | 69.6 | 67.70 | 73.6 | 69.6 | 72.76 | 78.2 | 69.6 | 76.40 | 63.8 | 73.9 | 65.91 | 81.6 | 67.4 | 78.63 | 69.0 | 56.5 | 66.39 |
| | 64.9 | 67.4 | 65.42 | 73.6 | 67.4 | 72.30 | 77.6 | 60.9 | 74.11 | 77.0 | 71.7 | 75.89 | 81.6 | 78.3 | 80.91 | 85.6 | 80.4 | 84.51 |
| | 75.3 | 71.7 | 74.55 | 74.7 | 76.1 | 74.99 | 75.9 | 78.3 | 76.40 | 70.1 | 60.9 | 68.18 | 71.3 | 78.3 | 72.76 | 79.9 | 69.6 | 77.75 |
| | 73.6 | 84.8 | 75.94 | 59.2 | 78.3 | 63.19 | 66.1 | 54.3 | 63.63 | 81.6 | 65.2 | 78.17 | 79.3 | 71.7 | 77.71 | 66.7 | 65.2 | 66.39 |
| | 68.4 | 67.4 | 68.19 | 74.7 | 71.7 | 74.07 | 73.6 | 73.9 | 73.66 | 71.3 | 76.1 | 72.30 | 78.2 | 69.6 | 76.40 | 82.8 | 69.6 | 80.04 |
| | 70.1 | 56.5 | 67.26 | 76.4 | 60.9 | 73.16 | 70.7 | 69.6 | 70.47 | 77.6 | 82.6 | 78.65 | 77.6 | 84.8 | 79.11 | 73.0 | 76.1 | 73.65 |
| | 76.4 | 71.7 | 75.42 | 74.7 | 71.7 | 74.07 | 79.3 | 67.4 | 76.81 | 63.2 | 60.9 | 62.72 | 72.4 | 60.9 | 70.00 | 78.7 | 71.7 | 77.24 |
| | 69.5 | 56.5 | 66.78 | 81.6 | 76.1 | 80.45 | 66.1 | 80.4 | 69.09 | 69.5 | 69.6 | 69.52 | 77.0 | 58.7 | 73.17 | 82.8 | 76.1 | 81.40 |
| | 71.3 | 65.2 | 70.02 | 71.8 | 71.7 | 71.78 | 83.3 | 69.6 | 80.44 | 79.9 | 73.9 | 78.65 | 71.3 | 60.9 | 69.13 | 78.2 | 71.7 | 76.84 |
| | 74.7 | 65.2 | 72.71 | 75.3 | 78.3 | 75.93 | 79.3 | 78.3 | 79.09 | 74.1 | 80.4 | 75.42 | 75.9 | 56.5 | 71.84 | 73.0 | 52.2 | 68.65 |
| | 77.0 | 69.6 | 75.45 | 72.4 | 65.2 | 70.89 | 79.9 | 63.0 | 76.37 | 82.8 | 69.6 | 80.04 | 75.3 | 76.1 | 75.47 | 74.1 | 60.9 | 71.34 |
| | 78.2 | 58.7 | 74.12 | 66.1 | 76.1 | 68.19 | 77.0 | 63.0 | 74.07 | 74.1 | 58.7 | 70.88 | 80.5 | 67.4 | 77.76 | 70.1 | 69.6 | 70.00 |
| | 73.0 | 63.0 | 70.91 | 64.4 | 63.0 | 64.11 | 79.9 | 69.6 | 77.75 | 72.4 | 73.9 | 72.71 | 82.2 | 69.6 | 79.57 | 65.5 | 63.0 | 64.98 |

Appendix 3: Results of Manual Testing of Rotation Data Trained Algorithms

| | | | | | | | | | | |
|------------|-------------------|------|------|------|------|------|------|------|------|------|
| Samples: | 223 to 232 | | | | | | | | | |
| | Actually Reported | | | | | | | | | |
| Pain | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| No Pain | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Predicted | | | | | | | | | |
| Function 2 | 0.55 | 0.98 | 0.67 | 1.00 | 0.82 | 0.11 | 0.79 | 1.00 | 0.28 | 0.83 |
| | 0.45 | 0.02 | 0.33 | 0.00 | 0.18 | 0.89 | 0.21 | 0.00 | 0.72 | 0.17 |
| Function 1 | 0.66 | 0.29 | 0.68 | 0.99 | 0.31 | 0.67 | 0.57 | 0.92 | 0.54 | 0.49 |
| | 0.34 | 0.71 | 0.32 | 0.01 | 0.69 | 0.33 | 0.43 | 0.08 | 0.46 | 0.51 |
| Function 3 | 0.57 | 0.46 | 0.71 | 0.99 | 0.53 | 0.30 | 0.36 | 0.92 | 0.80 | 0.69 |
| | 0.43 | 0.54 | 0.29 | 0.01 | 0.47 | 0.70 | 0.64 | 0.08 | 0.20 | 0.31 |
| Samples: | 211 to 220 | | | | | | | | | |
| | Actually Reported | | | | | | | | | |
| Pain | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| No Pain | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Predicted | | | | | | | | | |
| Function 2 | 0.18 | 0.70 | 0.77 | 0.06 | 0.13 | 0.81 | 0.13 | 0.84 | 0.33 | 0.69 |
| | 0.82 | 0.30 | 0.23 | 0.94 | 0.87 | 0.19 | 0.87 | 0.16 | 0.67 | 0.31 |
| Function 1 | 0.52 | 0.93 | 0.48 | 0.05 | 0.15 | 0.28 | 0.05 | 0.64 | 0.45 | 0.74 |
| | 0.48 | 0.07 | 0.52 | 0.95 | 0.85 | 0.72 | 0.95 | 0.36 | 0.55 | 0.26 |
| Function 3 | 0.34 | 0.60 | 0.17 | 0.29 | 0.44 | 0.07 | 0.22 | 0.83 | 0.26 | 0.87 |
| | 0.66 | 0.40 | 0.83 | 0.71 | 0.56 | 0.93 | 0.78 | 0.17 | 0.74 | 0.13 |