Survey selection of neural network parameters

There are 3 layers in a neural network: Input layer, hidden layer and output layer. The number of the input layer neurons is 6 corresponding to 6 factors of environment. The number of the output layer neurons is 1 corresponding to the result that indicates rain or no-rain. The number of hidden layer neurons is determined through the following test.

Assuming that after 150000 loops the neural network has not reduced the error to the expected level, it is considered that the neural network does not converge.

The test’s results:

***Test 1: Determine the learning rate***Learning rate can change over time at each loop. However, the system in the thesis is a small system, so learning rate we chose is constant.

Table 1: The convergence of different learning rate constants

|  |  |
| --- | --- |
| **Learning rate (η** | **The number of loops** |
| 0.4 | Not converge |
| 0.5 | Not converge |
| 0.6 | 142065 |
| 0.7 | 111883 |
| 0.8 | 111858 |
| 0.9 | 124058 |
| 1.0 | Not converge |

We do 10 tests on the same neural network which has 6 input layer neural, 15 hidden layer neurons and 1 output layer neural. The edge weight is initialized randomly between [-0.5, 0.5] and the maximum allowable error is 0.0005. The neural is trained with different learning rate values. The result is shown in Table 1. The network with learning rate η = 0.8 gives the fasted converge.

***Test 2: Determine the*** ***range of edge weight initialization values***

Table 2: The convergence of edge weight initialization value ranges

|  |  |
| --- | --- |
| **Initialization value ranges** | **The number of loops** |
| [-0.1, 0.1] | 162939 |
| [-0.2, 0.2] | 132162 |
| [-0.3, 0.3] | Not converge |
| [-0.4, 0.4] | 108633 |
| [-0.5, 0.5] | 111858 |
| [-0.6, 0.6] | 148246 |
| [-0.7, 0.7] | 108174 |
| [-0.8, 0.8] | 136780 |

We do 10 tests on the same neural network which has 6 input layer neural, 15 hidden layer neurons and 1 output layer neural. The learning rate is 0.8 and the maximum allowable error is 0.0005. The result is shown in Table 2.

The edge weights must be assigned differently, not too small or too large in order for the neural networks to converge. Appropriate initialization value is between [- 1, 1]. According to Table 2, we chose the range of [-0.7, 0.7] to use in the thesis because the neural network with this configuration has the smallest number of loops to converge.

***Test 3: Determine the number of hidden layer neural***We do 13 tests on the neural network which has 6 input layer neurons and 1 output layer neuron with different numbers of hidden layer neurons. The learning rate is 0.8 and the maximum allowable error is 0.0005. The range of edge weight initialization values is [-0.7, 0.7]. The result is shown in Table 3.

Table 3: The convergence of different numbers of hidden layer neurons

|  |  |
| --- | --- |
| **The number of hidden layer neurons** | **The number of loops** |
| 10 | Not converge |
| 11 | Not converge |
| 12 | Not converge |
| 13 | 175444 |
| 14 | 160718 |
| 15 | 108174 |
| 16 | 139839 |
| 17 | 171451 |
| 18 | 83250 |
| 19 | 105991 |
| 20 | 109077 |
| 30 | 133113 |
| 40 | 82765 |

Those neural networks with the number of hidden layer neurons bigger than 13 are able to converge and the one with 18 neurons in hidden layer give the smallest number of loops. With neural networks have 40 or more neurons in the hidden layer, convergence speed may be faster but not significant. Moreover, the trade of computer resources is high. Experiments have shown that hidden layer neurons are one of the factors that influence the convergence of the network during the learning process.