

Hidden nodes selection in hidden layer

Deciding the number of neurons in the hidden layer is a very important part of deciding your overall neural network architecture. Hidden layers do not directly interact with the external environment but still they have a tremendous influence on the final output. There are some various approaches to find out number of hidden nodes in hidden layer.

1. **Try and Error Method:** Try and error method characterised by repeated, varied attempts which are continued until success or until the agent stops trying. This method divides in to two approaches.
 - i) **Forward Approach:** This approach begins by selecting a small number of hidden neurons. We usually begin with two hidden neurons. After that train and test the neural network. Then increased the number of hidden neurons. Repeat the above procedure until training and testing improved.
 - ii) **Backward Approach:** This approach is opposite of Forward approach. In this approach we start with large number of hidden neurons. Then train and test the NN. After that gradually decrease the number of hidden neurons and again train and test the NN. Repeat the above process until training and testing improved.
2. **Rule of thumb method:** Rule of thumb method is for determining the correct number of neurons to use in the hidden layers, such as the following:
 - i) The number of hidden neurons should be in the range between the size of the input layer and the size of the output layer.
 - ii) The number of hidden neurons should be $2/3$ of the input layer size, plus the size of the output layer.
 - iii) The number of hidden neurons should be less than twice the input layer size.
3. **Simple Method:** It is a simple method to find out neural network hidden nodes. Assume a back propagation NN configuration is l-m-n. Here l is input nodes, m is hidden nodes and n is output nodes. If we have two inputs and two outputs in our problem then we can take same number of hidden nodes. So our configuration becomes 2-2-2 where 2 is input nodes, 2 is hidden nodes, 2 is output nodes.
4. **Two phase method:** In two phase method the termination condition is same as the trial and error method but in a new approach. In this method data set is dividing into four groups. Among all four groups two groups of data are used in first phase to train the network and one group of remaining data set is used in second phase to test the network. Last group of data set is used to predict the output values of the train network. This experiment is repeated for different number of neurons to get minimum number of error terms for selecting the number of neurons in the hidden layer.
5. **Sequential orthogonal approach:** Another approach to fix hidden neuron is the sequential orthogonal approach. This approach is about adding hidden neurons one by one. Initially, increase N_h sequentially until error is sufficiently small. When adding a

neuron, the new information introduced by this neuron is caused by that part of its output vector which is orthogonal to the space spanned by the output vectors of previously added hidden neurons. An additional advantage of this method is that it can be used to build and train neural networks with mixed types of hidden neurons and thus to develop hybrid models