

XOR and AND Approximation NN, Nano-Level Structure

At the lower level the structure of the Neural Networks overloading the XOR and AND operators is shown in the figure below. On the Nano Level these two described neural networks has same architecture - shallow 2 layer networks with tanh-sigmoidal and log-sigmoidal activations. We use two inputs $X1$ and $X2$ in R , and one output Y in R space. (Note the weight of the network for AND and XOR operators are different).

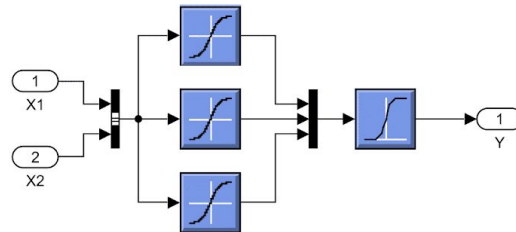
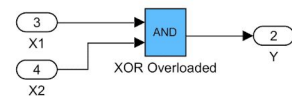


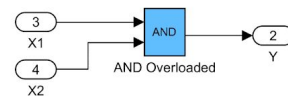
Fig. 1.1 XOR and AND Approximation Neural Networks, nano-level

XOR and AND Approximation NN, Micro-Level Structure

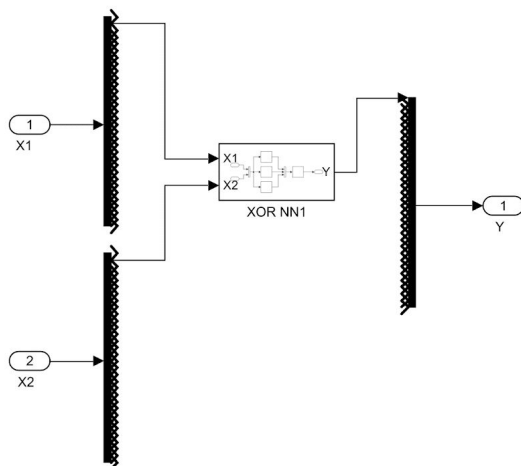
The structure of the XOR and AND approximation Neural networks (in tandem with shortcuts used for the overloads) are displayed as per block-scheme below.



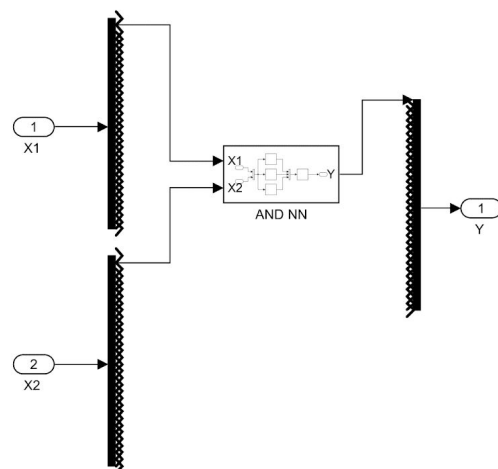
XOR (As displayed)



AND (As displayed)



XOR Overloaded
(Block-Scheme)



AND Overloaded
(Block-Scheme)

Fig. 1.2 a) XOR Neural

Fig. 1.2. b) AND Neural Network

From the Fig. 1.7. observe the both networks uses the k -th (contemporaneous) bit of inputs X_1 and X_2 and provide k -th bit of Y in the output.(With bit undersoon the equivalent in R).

XOR and AND Approximation NN, Results

The two layer NN converge perfectly. The 2 neurons in in the hidden (tanh-sigmoid) layer are sufficient to reach 100% accuracy. However the several realizations failed to reach 100% accuracy most probably due to weight initialization.

The both XOR and AND Neural Network converge perfectly. 2 neurons are sufficient to reach 100% accuracy in all sets.

The several realizations were not able to provide 100% accuracy, the accuracy checks (of the level 100% to be established). (Restricted Pass)
--



Fig. 1.3. Confusion Matrix of XOR Neural Network (perfect accuracy reached)

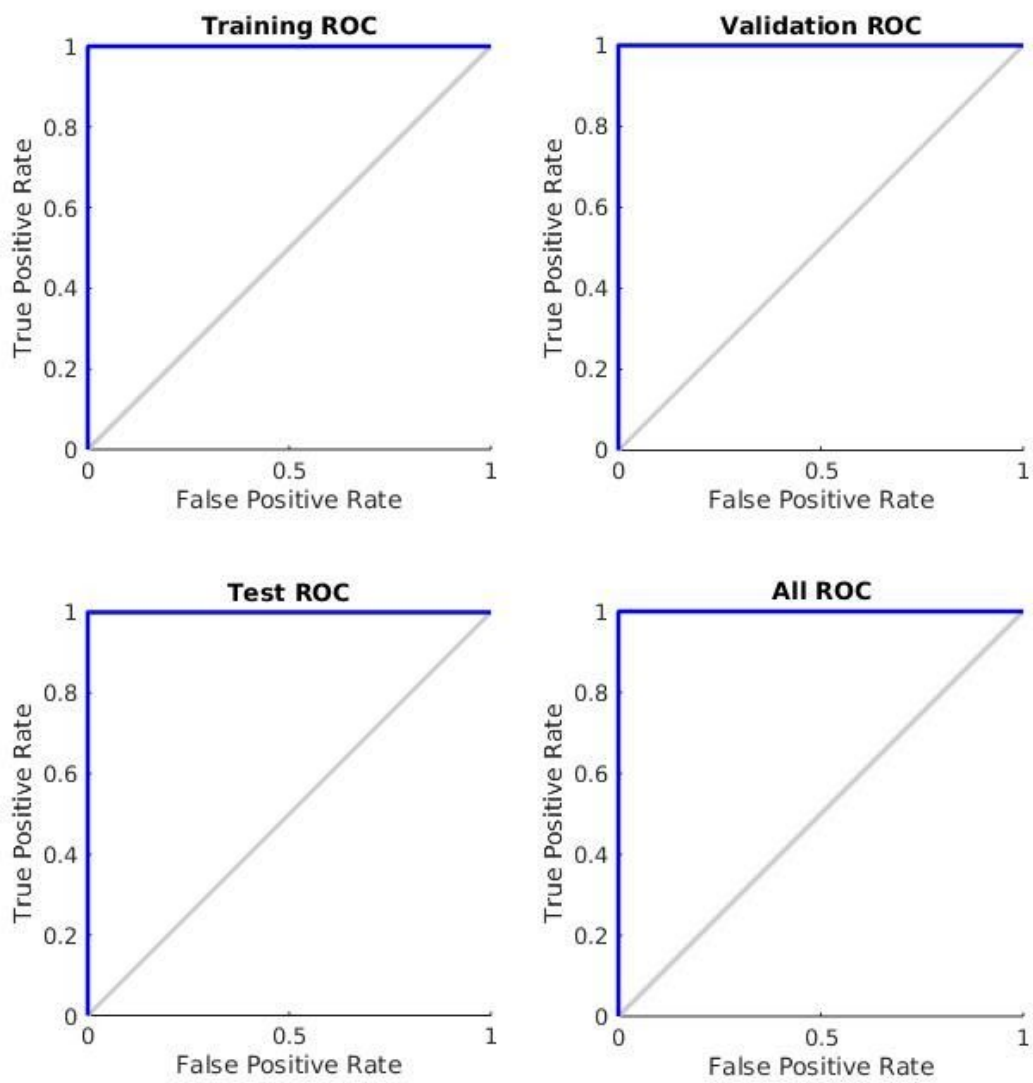


Fig. 1.4. ROC Curve of XOR Neural Network (perfect accuracy reached)



Fig. 1.5. Confusion Matrix of AND Neural Network (perfect accuracy reached)

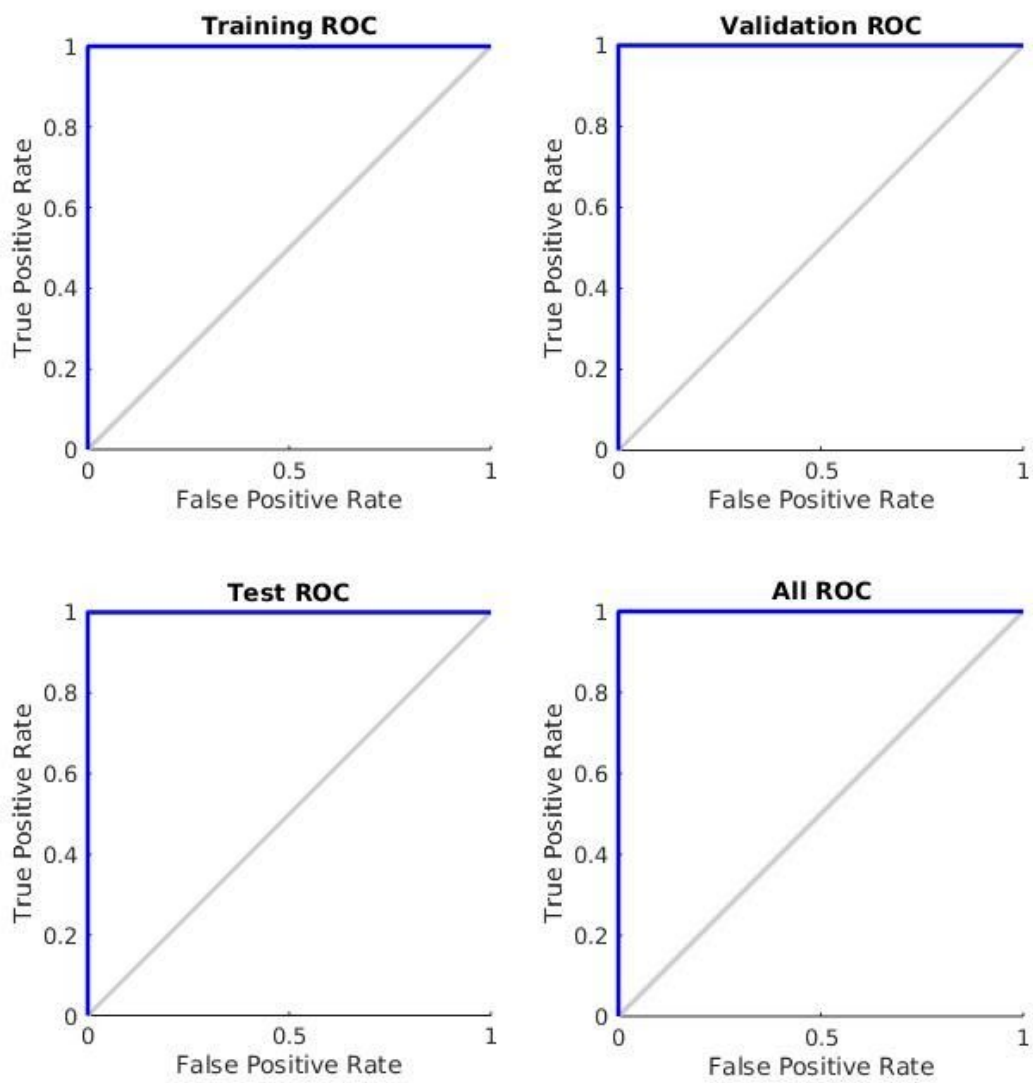


Fig. 1.6. ROC Curve of AND Neural Network (perfect accuracy reached)