

**Neural Network Classification System
Using
SNNS and MATLAB Software**

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03-07-2005

Problem

Build and train a neural network using the MATLAB and/or SNNS packages.

Methodology

Network Configurations

In total, 30 networks have been created to run the set of test cases. They have been constructed as follows. As suggested, networks have been constructed using either 5, 10, or 15 nodes in the hidden layer. For each of these possibilities, there are 10 variations. These variations differ only in the data that they will be trained and tested using. All networks use logsig as the transfer function for both layers. This was chosen since it does not make much sense to use purelin or tansig due to the fact that we do not require any negative numbers. Also, testing showed that the two logsig configuration gave the most (the only) reasonable results. The training function used in all networks is MATLAB'S TRAINLM function. This may have been a poor choice since changing the learning rate does not seem to affect the results, but it was the only one that brought the performance to a usable level for the given data in a reasonable time. It is a very fast algorithm, so it completes the training without the number of epochs never gets very high, but it has high memory/space usage since it must store and do operations on matrices. The networks also use MATLAB'S LEARNNGDM (Gradient descent with momentum) learning function. These configurations seem to give meaningful results that can be analysed.

Test Data

Ten different data sets have been constructed for training and testing the networks. Each training set is the input set with two birds removed giving test vectors from the following birds:

- Test 1 - Common Loon (1), Western Grebe(4)
- Test 2 - Laysan Albatross (8), White Pelican (11)
- Test 3 - Mallard (15), Peregrin Falcon (20)
- Test 4 - Turkey (25), Great Blue Heron (29)
- Test 5 - Whooping Crane (33), American Avocet (37)
- Test 6 - Rock Dove (41), Yellow Billed Cuckoo (45)
- Test 7 - Snowy Owl (49), Common Nighthawk (53)
- Test 8 - Black Swift (57), Thick Billed Parrot (61)
- Test 9 - Rufous Hummingbird (58), Coppery Tailed Trogon (63)
- Test 10 - Pileated Woodpecker (66), Common Raven (70)

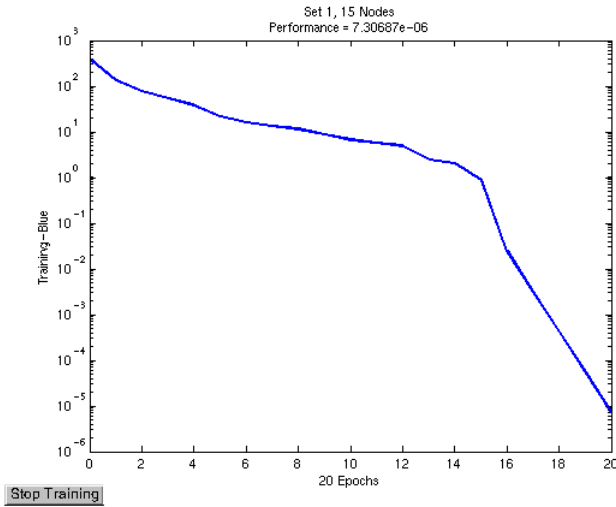
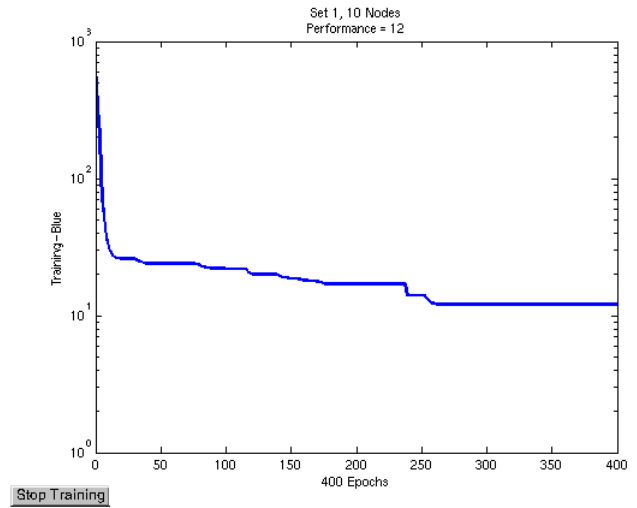
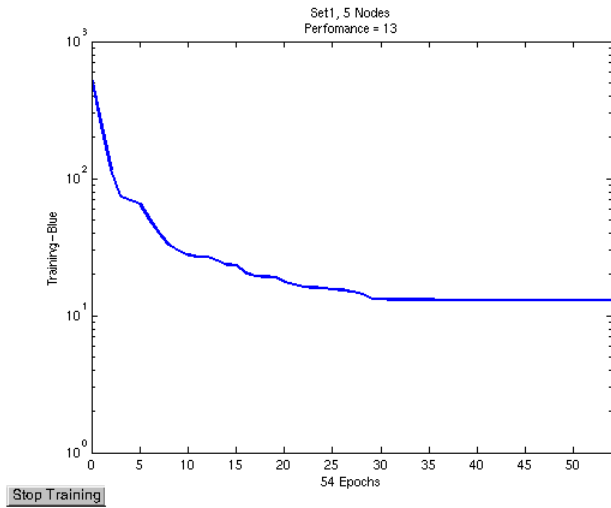
The test vectors for the most part follow the form of one from each the first two groups, one from each of the next two groups, and so on. The only exception is the case where the Coppery Tailed Trogon is involved. Since it is alone in its class, it was paired with a bird from a class that had four choices, instead of one from a class containing two birds, which would have been the case if the form was followed. While this strategy may not give the most correct results, hopefully the performance can be compared to that of another student and result in some valuable information.

Training Parameters

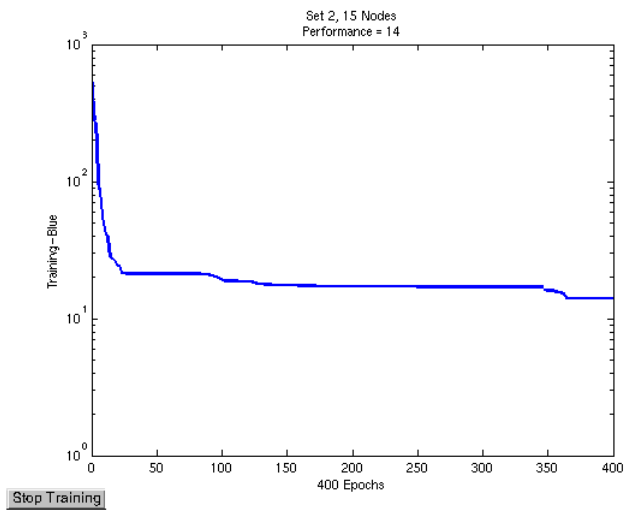
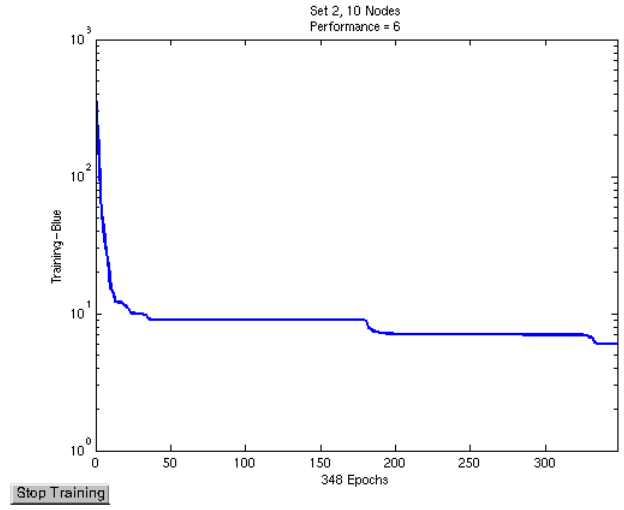
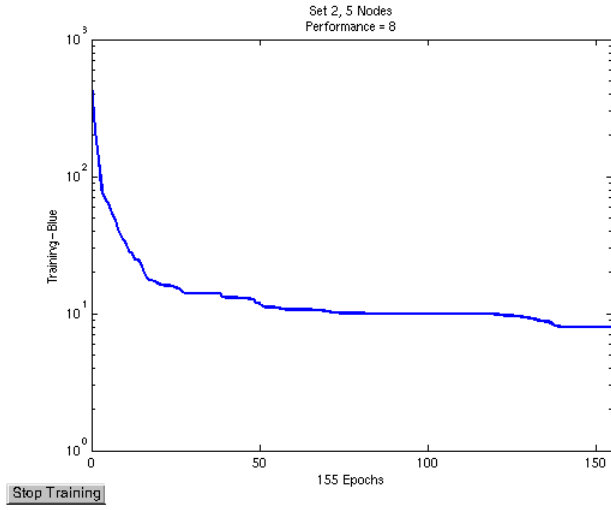
Test Results

Training Results

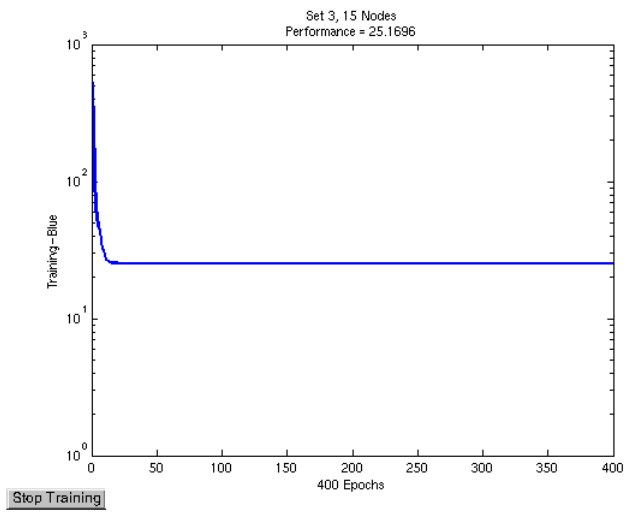
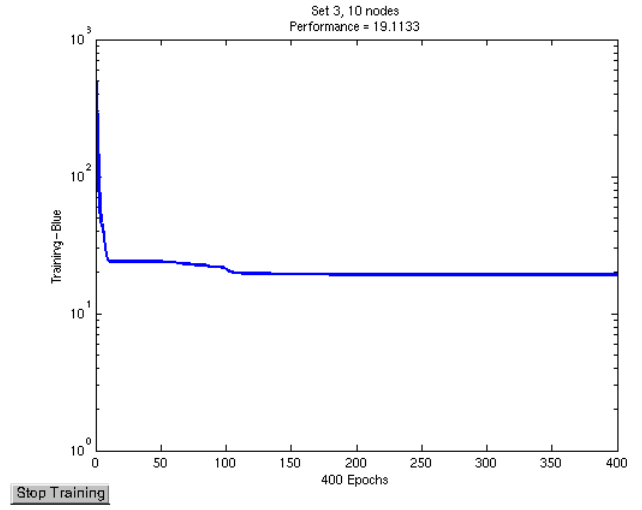
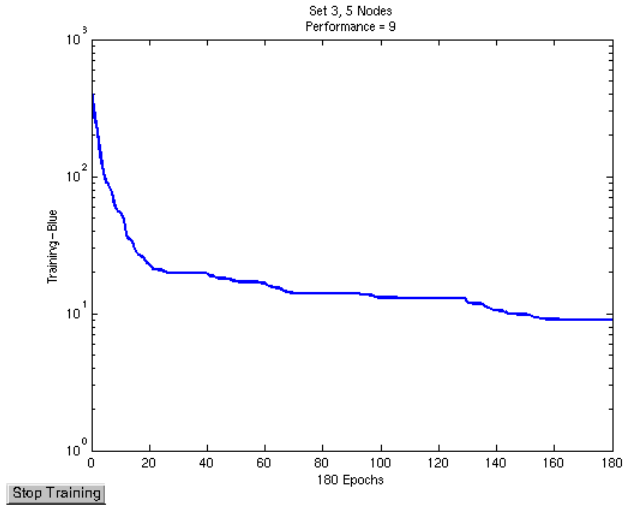
Set 1 - Common Loon (1) and Western Grebe(4)



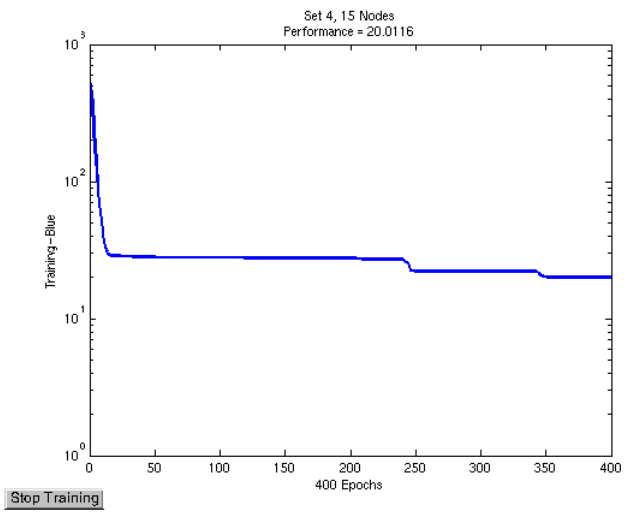
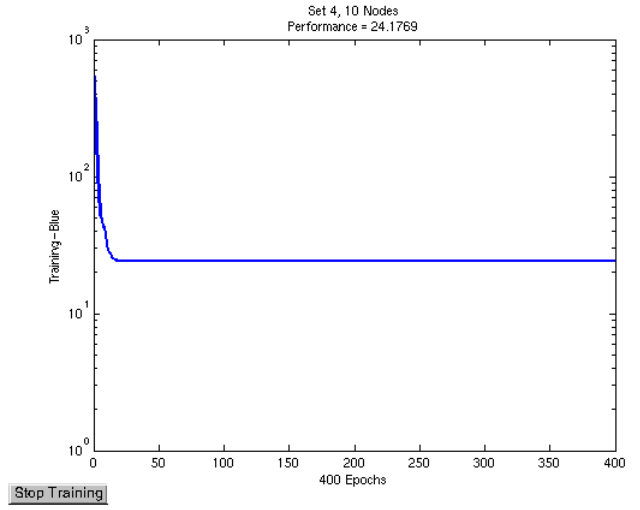
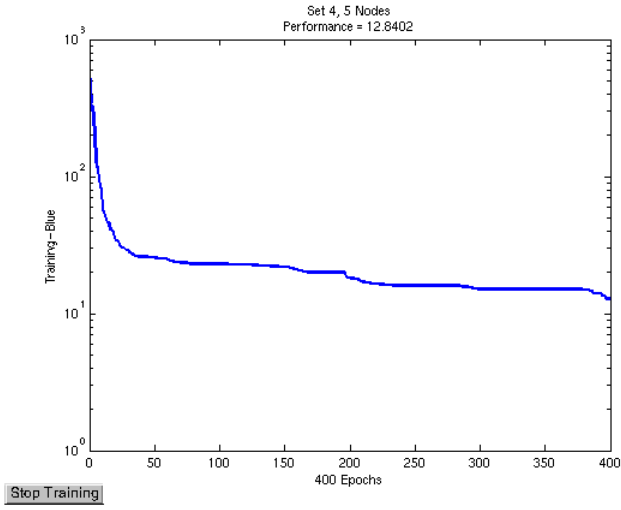
Set 2 - Laysan Albatross (8) and White Pelican (11)



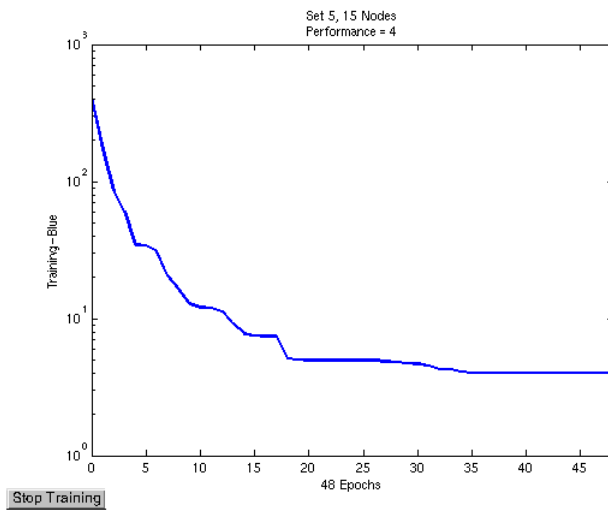
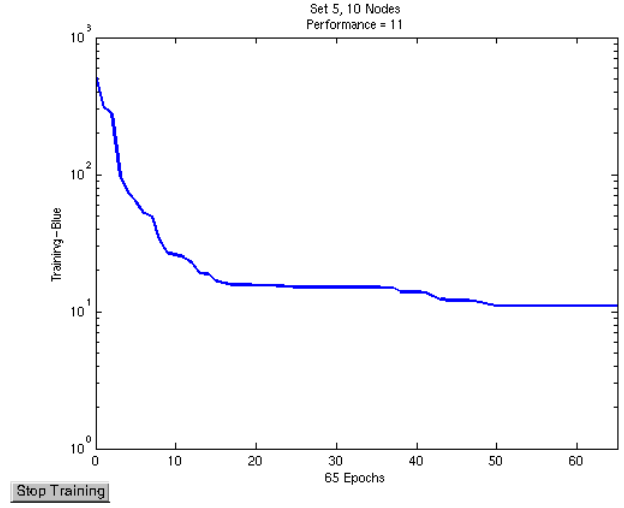
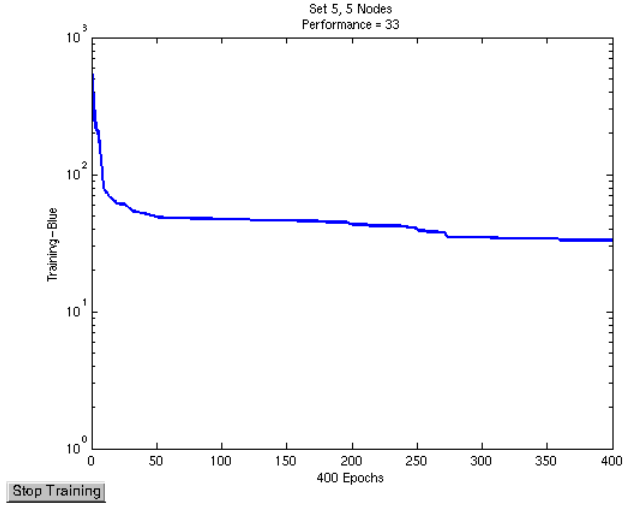
Set 3 - Mallard (15) and Peregrin Falcon (20)



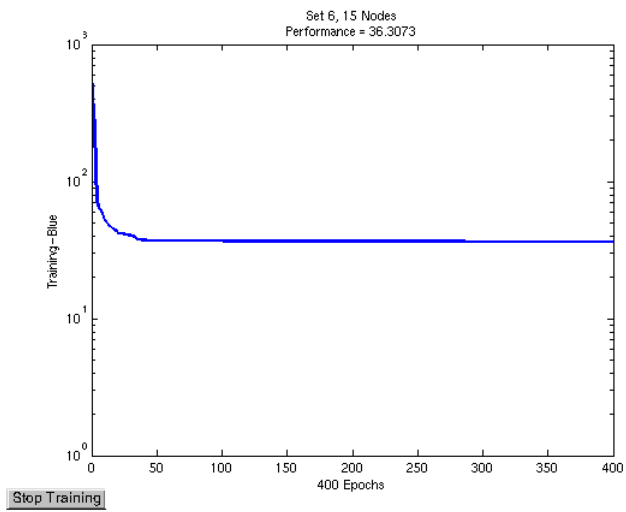
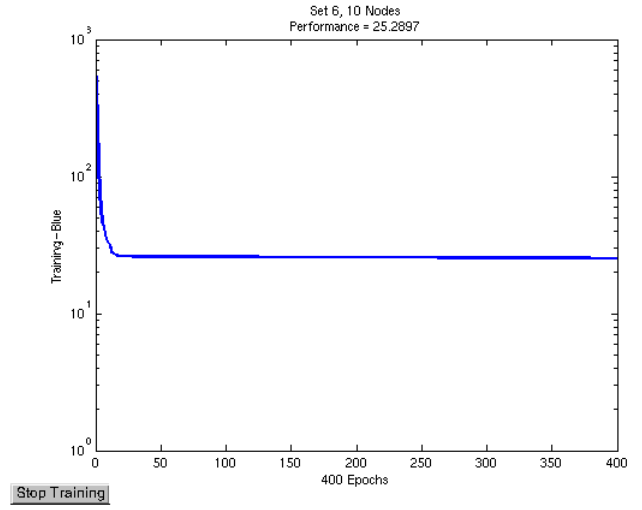
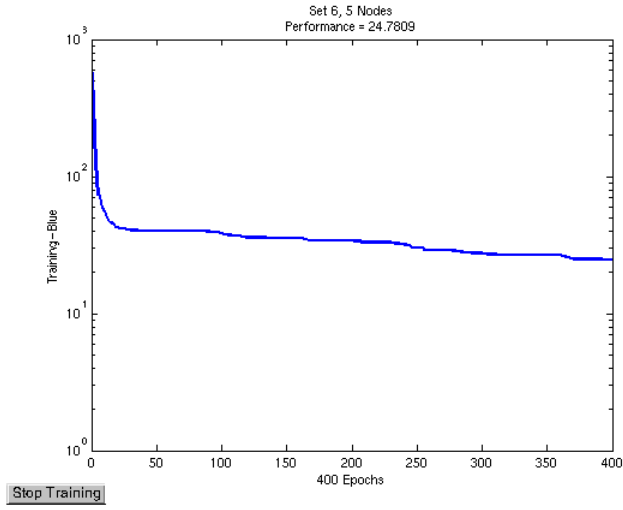
Set 4 - Turkey (25) and Great Blue Heron (29)



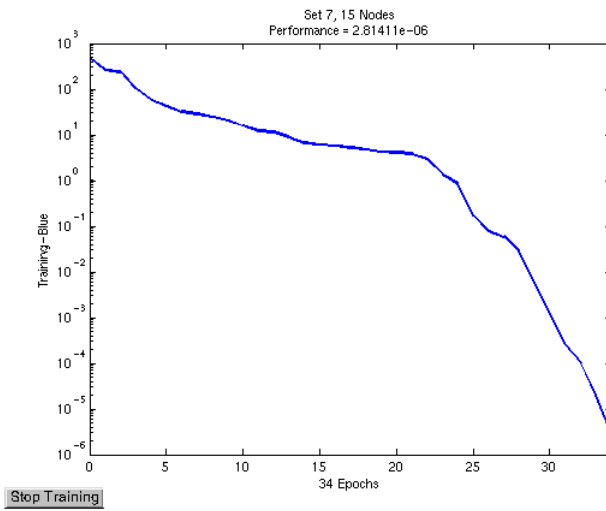
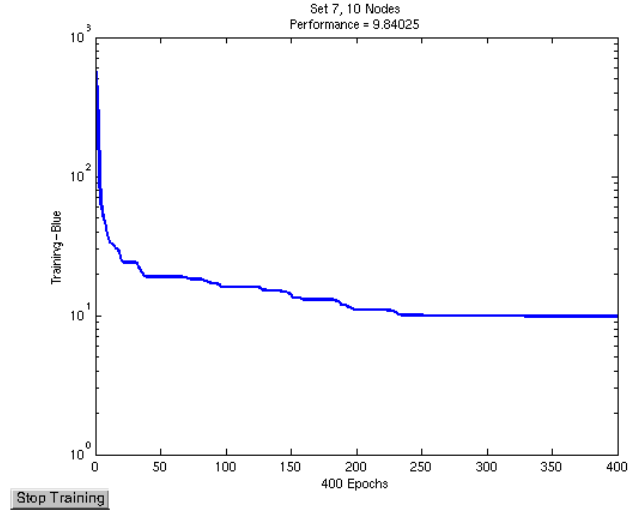
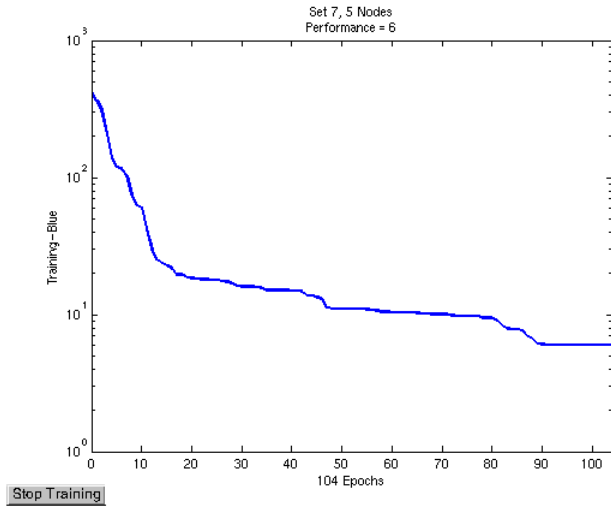
Set 5 - Whooping Crane (33) and American Avocet (37)



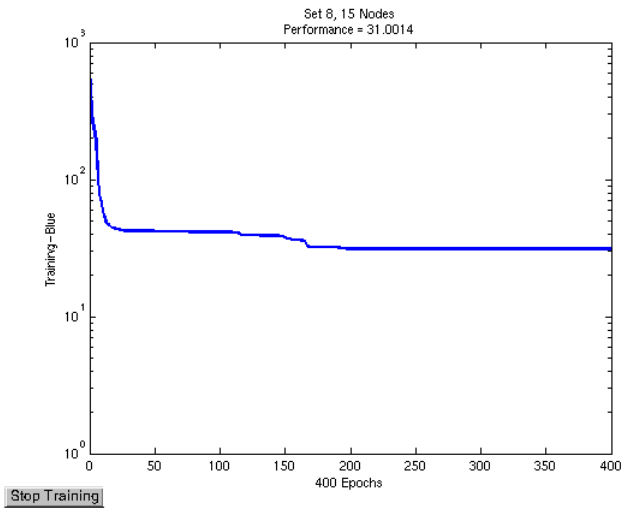
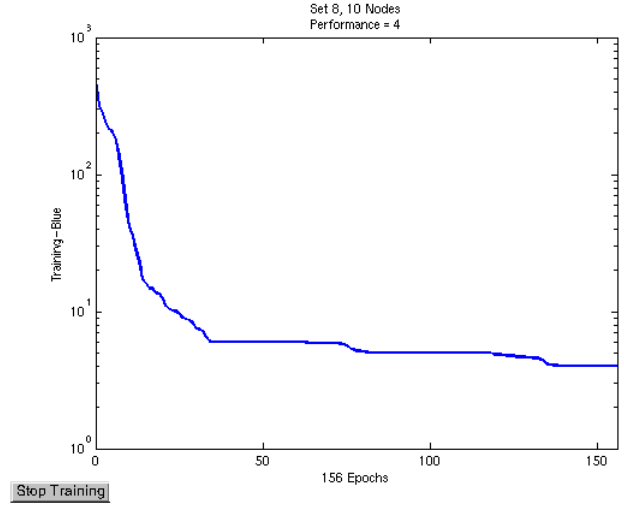
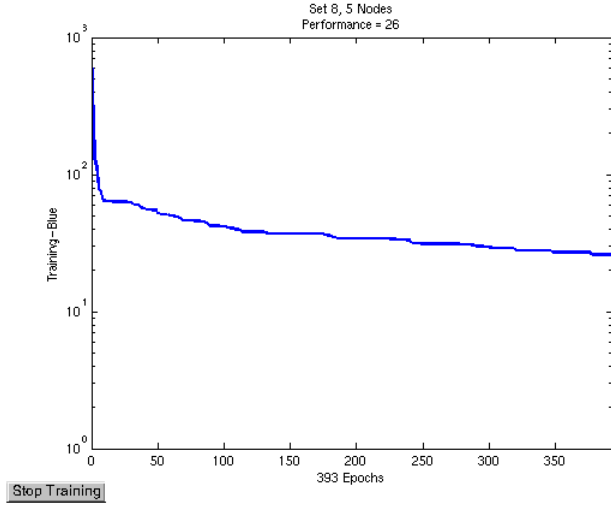
Set 6 - Rock Dove (41) and Yellow Billed Cuckoo (45)



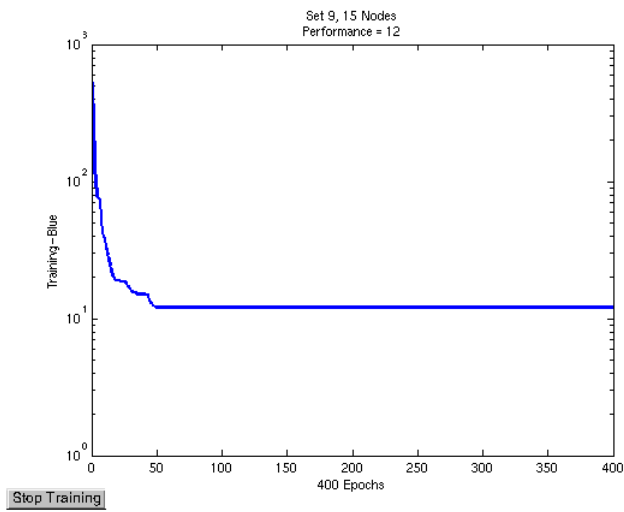
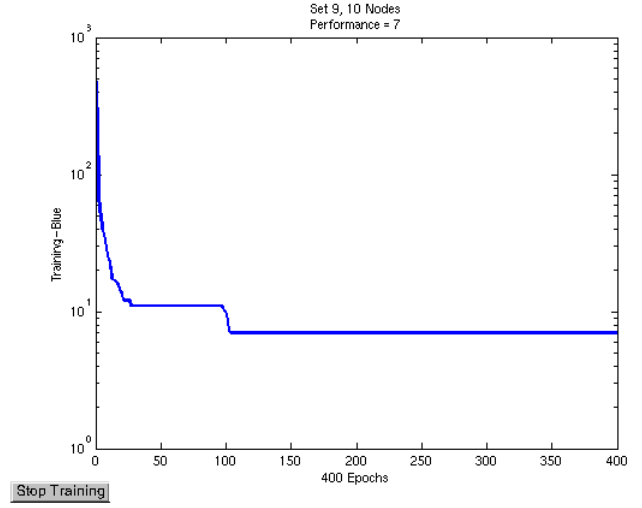
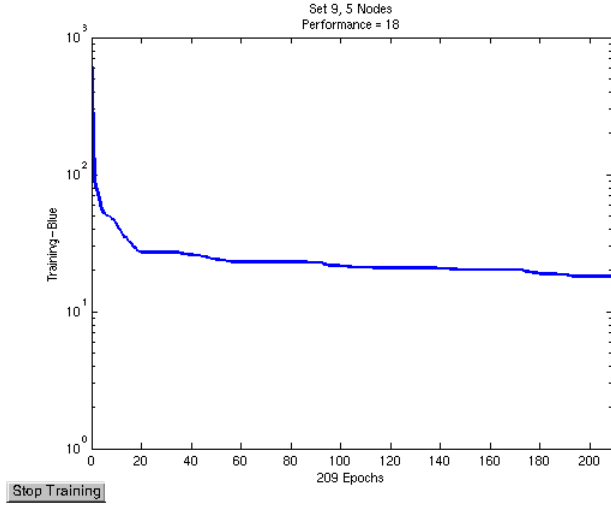
Set 7 - Snowy Owl (49) and Common Nighthawk (53)



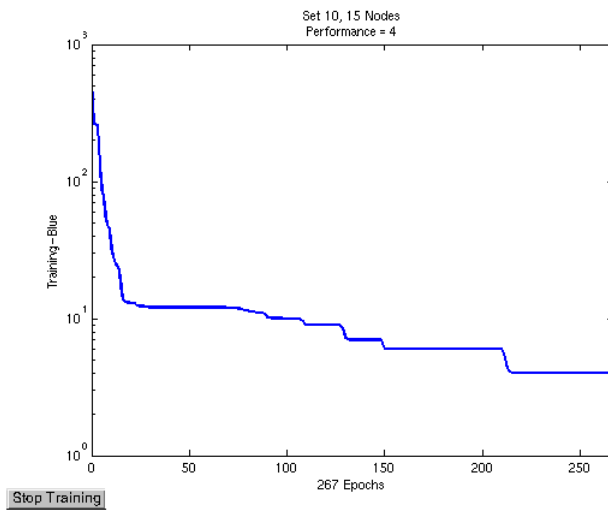
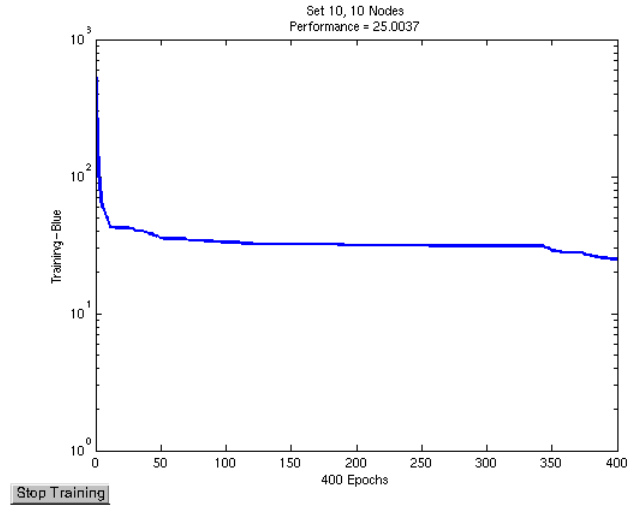
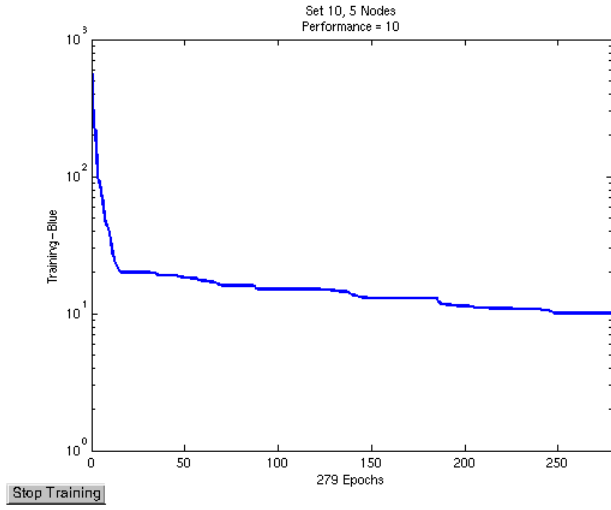
Set 8 - Black Swift (57) and Thick Billed Parrot (61)



Set 9 - Rufous Hummingbird (58) and Coppery Tailed Trogon (63)



Set 10 - Pileated Woodpecker (66) and Common Raven (70)



Set 4 - Turkey (25) and Great Blue Heron (29)

Bird 25 - Turkey			
Hidden Nodes	Score	Expected	Found
5	Pass	0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0557 0 0 0 0 0 0 0 0 0 0.9174 0 0 0 0 0 0 0 0 0
15	Pass	0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0.68 0 0 0 0 0.0086 0 0 0 0 0 0 0 0

Bird 29 - Great Blue Heron			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0.0337 0 0 0 0 0 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0.8481 0.5576 0.0321 0 0 0 0 0 0 0 0 0
15	Fail	0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

Set 5 - Whooping Crane (33) and American Avocet (37)

Bird 33 - Whooping Crane			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0.8967 0 0 0 0 0 0 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0.009 0.004 0 0 0.132 0 0 0 0.007 0 0 0 0 0 0
15	Fail	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0

Bird 37 - American Avocet			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.4786 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	0.188 0 0 0 0 0 0.4271 0 0 0.0022 0 0 0 0 0.9733 0 0 0 0 0
15	Fail	0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0.9983 0 0 0 0 0 0 0 0 0 0 0 0

Set 6 - Rock Dove (41) and Yellow Billed Cuckoo (45)

Bird 41 - Rock Dove			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 0 0 0.0013 0 0 0.0058 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0.047 0 0.005 0 0.025 0.012 0 0 0 0 0 0.015 0 0
15	Fail	0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	0 0 0 0 0.014 0 0.189 0 0 0 0.005 0 0 0 0.461 0 0 0.005 0 0 0

Bird 45 - Yellow Billed Cuckoo			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.1264 0 0.0669 0.4334 0 0
10	Fail	0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0.0299 0 0 0.0134 0 0 0.0995 0 0
15	Fail	0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0	0 0 0 0 0.003 0.1239 0 0 0 0 0 1 0 0 0 0.004 0 0 0.002 0

Set 7 - Snowy Owl (49) and Common Nighthawk (53)

Bird 49 - Snowy Owl			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0	0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
10	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0	0 0 0 0 0.0003 0 0.0006 0 0 0 0 0 0.0039 0 0 0 0 0 0 0
15	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0.1603 0 0 0 0 0 0 0.9978 0 0 0 0 0 0 0

Bird 53 - Common Nighthawk			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	0 0 0 0 0 1 0 0 0 0 0 0 0 0.9966 0 0 0 0.5745 0 0
15	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	0 0 0 0 0 0.0032 0 0 0.0301 0.9312 0 0 0 0.0247 0.0486 0 0

Set 8 - Black Swift (57) and Thick Billed Parrot (61)

Bird 57 - Black Swift			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0	0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
10	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0	0 0 0 0 0 0.0031 0 0 0 0 0 0 0 0 1 0 0.0034 0 0 0
15	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0	0 0 0 0 0 0.015 0 0 0 0 0.0065 0 0 0 0.0029 0 0 0 0

Bird 61 - Thick Billed Parrot			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
10	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0.0034 0 0 0 0 0.0161 0 0 0 0 1 0 0 0 0
15	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0.0038 0 0 0 0 0.9664 0 0 0 0

Set 9 - Rufous Hummingbird (58) and Coppery Tailed Trogon (63)

Bird 58 - Rufous Hummingbird			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0.005 0 0 0 0 0.696 0.039 0 0 0 0.007 0 0 0 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.0392 0 0
15	Pass	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0.0006 0 0 0.0017 0 0 0 0

Bird 63 - Coppery Tailed Trogon			
Hidden Nodes	Score	Expected	Found
5	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0
10	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0.9929 0 0 0 0 0 0 0
15	Fail	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0.0847 0 0 0 0 0 0 0

