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CSC447 – Artificial Intelligence
Program 1 Data & Questions

Try training with different numbers of months of PDSI data, or burned acreage, or different fire severity breakpoints, to see if you can get better results.

Testing ANNTest with one run of the ANNTrain

When there are different severity break points there is not a large difference in the average RMS error and the accuracy. The test runs can be seen below:

Test 1:

Break point between low and mid:	1000
Break point between mid and high:	10000
Average RMS Error:	0.299
Accuracy:	88.89%

Test 2:

Break point between low and mid:	100
Break point between mid and high:	1000
Average RMS Error:	0.169
Accuracy:	86.11%

Test 3:

Break point between low and mid:	10000
Break point between mid and high:	100000
Average RMS Error:	0.356
Accuracy:	100.00%

Test 4:

Break point between low and mid:	500
Break point between mid and high:	50000
Average RMS Error:	0.222
Accuracy:	91.67%

Test 5:

Break point between low and mid:	100
Break point between mid and high:	500000
Average RMS Error:	0.18
Accuracy:	94.44%

Testing ANNTest with one run of the ANNTrain

When the net is given a higher momentum the net trains better. The test runs can be seen below:

Test 1:

Momentum:	0.8
Original RMS Error:	0.463
RMS Error after 2000 Epochs:	0.0825

Test 2:

Momentum:	0.1
Original RMS Error:	0.117

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RMS Error after 2000 Epochs: 0.113

Test 3:
- Momentum: 1
- Original RMS Error: 0.423
- RMS Error after 2000 Epochs: 0.34

Test 4:
- Momentum: 0.3
- Original RMS Error: 0.543
- RMS Error after 2000 Epochs: 0.0892

When the net is given a higher learning rate the training is more likely to converge on a local minimum. The test runs can be seen below:

Test 1:
- Learning Rate: 0.4
- Original RMS Error: 0.463
- RMS Error after 2000 Epochs: 0.0825

Test 2:
- Learning Rate: 0.1
- Original RMS Error: 0.56
- RMS Error after 2000 Epochs: 0.0885

Test 3:
- Learning Rate: 0.7
- Original RMS Error: 0.443
- RMS Error after 2000 Epochs: 0.215

Test 4:
- Learning Rate: 1
- Original RMS Error: 0.453
- RMS Error after 2000 Epochs: 0.147

By looking at our test data when running the ANNTrain one time, the higher the number of epochs typically gives a better end RMS error. The 4th test does not show that this is true, but there is a chance that the 4th test was stuck in a local minimum.

Test 1:
- Number of Epochs: 2000
- RMS Error on 1990 Epoch: 0.122

Test 2:
- Number of Epochs: 10000
- RMS Error on 1990 Epoch: 0.0902

Test 3:
- Number of Epochs: 100000
- RMS Error on 1990 Epoch: 0.0986

Test 4:
- Number of Epochs: 500000

RMS Error on 1990 Epoch: 0.108

Testing Network Topology
Epocs: 2000
Learning Rate: 0.4
Momentum: 0.8
Threshold for ANN Error: 0.01
Years Burned Acerage: 3
Number of Months of PDSI Data: 36
End month: 3
Output classes: 3
Cutoffs: 1000, 10000
Tested using the Black Hills PDSI and burned acerage input data, with ditterent topology:

Test #1:
- Topology: 39 20 3
- Training Average RMS: 0.037
- Testing Accuracy: 94.29%
- Cross Validation Accuracy: 51.43%
  - (note: Cross Validation took 34 minutes to run this test on Windows - all later tests were done on Linux)

Test #2:
- Topology: 39 4 3
- Training Average RMS: 0.0099 (Error threshold hit at epoch 841)
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 60.0%
  - (note: this was the best cross validation accuracy acheived, later tests with the same parameters had accuracy around 57%)

Test #3:
- Topology: 39 7 4 3
- Training Average RMS: 0.0155
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 54.29%

Test #4:
- Topology: 39 12 4 3
- Training Average RMS: 0.00968 (Error threshold hit at epoch 941)
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 48%

Test #5:
- Topology: 39 15 4 3
- Training Average RMS: 0.00968 (Error threshold hit at epoch 701)
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 51%

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Test #6:
- Topology: 39 19 4 3
- Training Average RMS: 0.00982 (Error threshold hit at epoch 491)
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 54%

Test #7:
- Topology: 39 25 4 3
- Training Average RMS: 0.00995 (Error threshold hit at epoch 422)
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 54%

Test #8:
- Topology: 39 19 10 4 3
- Training Average RMS: 0.00993
- Testing Accuracy: 100.00%
- Cross Validation Accuracy: 51.43%

Test #9:
- Topology: 26 4 3 (With 24 months PDSI and 2 years burned acreage)
- Training Average RMS: 0.0837
- Testing Accuracy: 94.44%
- Cross Validation Accuracy: 52.78%

Test #10:
- Topology: 14 4 3 (With 12 months PDSI and 2 years burned acreage)
- Training Average RMS: 0.12
- Testing Accuracy: 91.67%
- Cross Validation Accuracy: 44.44%

Test #11:
- Topology: 52 4 3 (With 48 months PDSI and 4 years burned acreage)
- Training Average RMS: 0.0422
- Testing Accuracy: 97.06%
- Cross Validation Accuracy: 41.18%

What is the impact of network topology (i.e., changing the number of hidden layer nodes) on training?

The net learned fastest with four layers and the topology in Test #7 (topology 39 25 4 3). It may train faster with more nodes in the second layer, but the epoch where training hit the error threshold started to level off, and Cross Validation wasn't getting significantly better. Rerunning Test #8 (topology 39 19 10 4 3) produced wild results - one test even untrained itself between epoch 650 and 660, going from RMS error 0.26 to 0.416. In general, the best amount of input was with 36 months of PDSI data and 3 years of burned acreage data. Test #2 yielded the best Cross Validation accuracy we had gotten.

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How well does your network train?

With two years of burned acreage, twelve months of PDSI data, one hidden layer of four hidden neurons, a learning rate of 0.4, and a momentum of 0.8, the net will usually train from an RMS error of approximately 0.5 to a RMS error of approximately 0.1 in about 1000 training epochs.

How well does the network generalize from training data to testing data?

In general, when the network has low training average RMS error, the testing has high accuracy. While testing RMS error got very low very fast on some topologies, the specific topology does not generalize well for new data when cross validation.