CSC 369 2.0 - Machine Learning I
Individual Assignment

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Contents

Chapter 1

Introduction

This report is based on Individual Assignment which was done under CSC 369 2.0 - Machine Learning I course. Assignment was on implementation of an algorithm for feed forward neural network which can be used for IRIS plant classification.

1.1 Neural Network

A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria. The concept of neural networks, which has its roots in artificial intelligence, is swiftly gaining popularity in the development of trading systems.

1.2 Classification

Classification is the process of predicting the class of given data points. Classes are sometimes called as targets/ labels or categories. Classification predictive modeling is the task of approximating a mapping function (f) from input variables (X) to discrete output variables (y).

1.3 Classification by Backpropogation

Backpropagation is a neural network learning algorithm. The neural networks field was originally kindled by psychologists and neurobiologists who sought to develop and test computational analogs of neurons. Roughly speaking, a neural network is a set of connected input/output units in which each connection has a weight associated with it. During the learning phase, the network learns by adjusting the weights so as to be able to predict the correct class label of the input tuples. Neural network learning is also referred to as connectionist learning due to the connections between units.

1.4 A Multilayer Feed-Forward Neural Network

The backpropagation algorithm performs learning on a multilayer feed-forward neural network. It iteratively learns a set of weights for prediction of the class label of tuples. A multilayer feed-forward neural network consists of an input layer, one or more hidden layers, and an output layer.

1.5 IRIS Data set

The Iris flower data set is a multivariate data set introduced by the British statistician and biologist Ronald Fisher in his 1936 paper The use of multiple measurements in taxonomic problems. It is sometimes called Anderson's Iris data set because Edgar Anderson collected the data to quantify the morphologic variation of Iris flowers of three related species. The data set consists of 50 samples from each of three species of Iris (Iris Setosa, Iris virginica, and Iris versicolor). Four features were measured from each sample: the length and the width of the sepals and petals, in centimeters.

In this assignment to implement an algorithm for IRIS Plant Classification a multilayer feed forward neural network was used. the structure of the neural network is 4-3-1. There are 4 nodes in the input layer, 3 nodes in the hidden layer and 1 node i n the output layer. Logsigmoid function was used as the activation function of each layer.

$$f(x) = \frac{1}{1 + \exp(-x)} \tag{1.1}$$

This Neural Network is taken width and length of sepal and petal of given flower and then it returns which class of IRIS that the flower belongs. IRIS classes have been defined in above. 25 instances of each class in IRIS data set were taken to train the Neural Network and remainings were kept for testing.

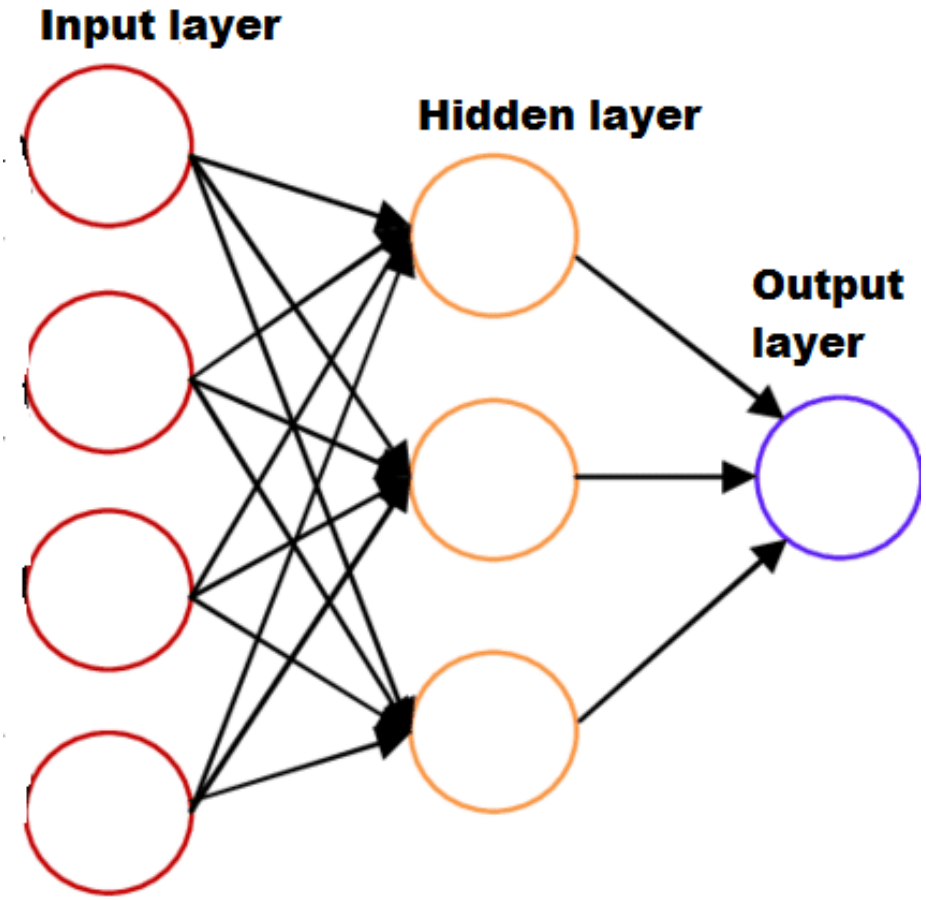

Figure 1 : Nural Network Architecture used here

Chapter 2

Methodology

- Firstly given Research Paper about AN APPROACH FOR IRIS PLANT CLASSIFICATION USING NEURAL NETWORK wich was propsed by M. Swain was understood.
- Then Model proposed for IRIS Classification in the paper was deeply studied.
- After that MATLAB 2014R was installed.
- IRIS Data set was downloaded.
- Data set was divided into two parts that 75 instances were included in each part. One part was for the training purpose and other part was testing purpose.
- Then Implementation of the algorithm was started.
- In implementation firstly test data were Normalized. Then all weights in the network, No of ephocs, Learning Rate were initialized. Then the inputs were propagated forward in the network. Error of the each node was calculated. According to error weights were updated. Finally network was tested for 500, 1000 and 5000 ephocs using test data.

Chapter 3

Results

The MATLAB version used is R2010a. The IRIS dataset (downloaded from the UCI repository,www.ics.uci.edu, which is a 1504 matrix, is taken as the input data. Out of these 150 instances, 75 instances were used for training and 75 for testing. Under supervised learning, the target of the first 25 instances is taken as 0, for the next 25 instances as 0.5 and for the last 25 instances as 1. The network architecture taken was 431, i.e, the input layer has 4 nodes, the hidden layer has 3 nodes and the output layer has 1 node. The tolerance value taken was 0.01.

3.1 No of ephocs = 500

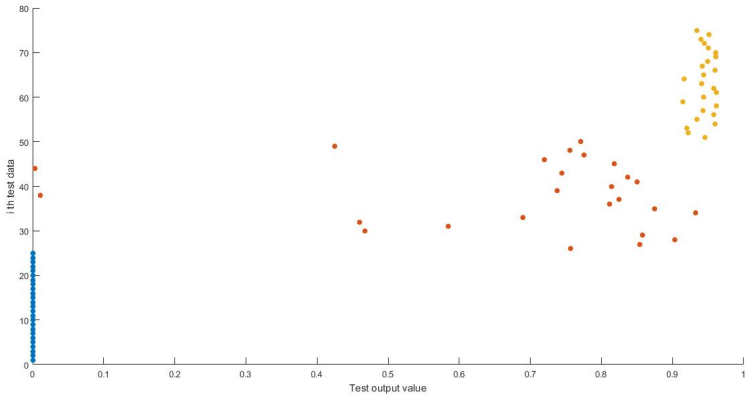

Figure 2 : Result of classification for 500 epochs at Learning Rate = 0.7.

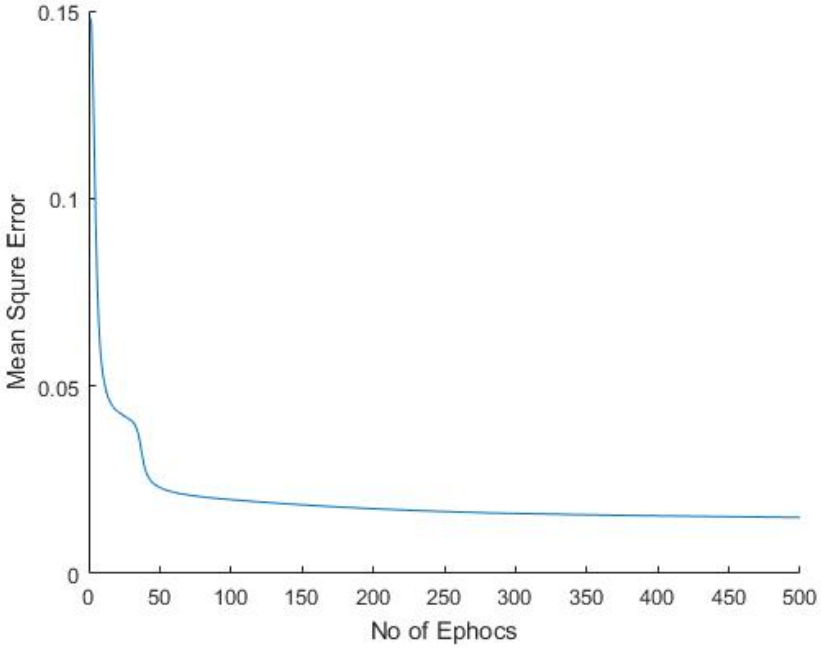

Figure 3 : For 500 Epochs vs. Mean Squre Error at Learning Rate = 0.7.

IRIS Plant	Total	Classified	Not Classified
Setosa	25	25	0
Versicolor	25	4	21
Virginnica	25	8	13

Table 3.1: Test data classification for 500 Epochs

3.2 No of ephocs = 1000

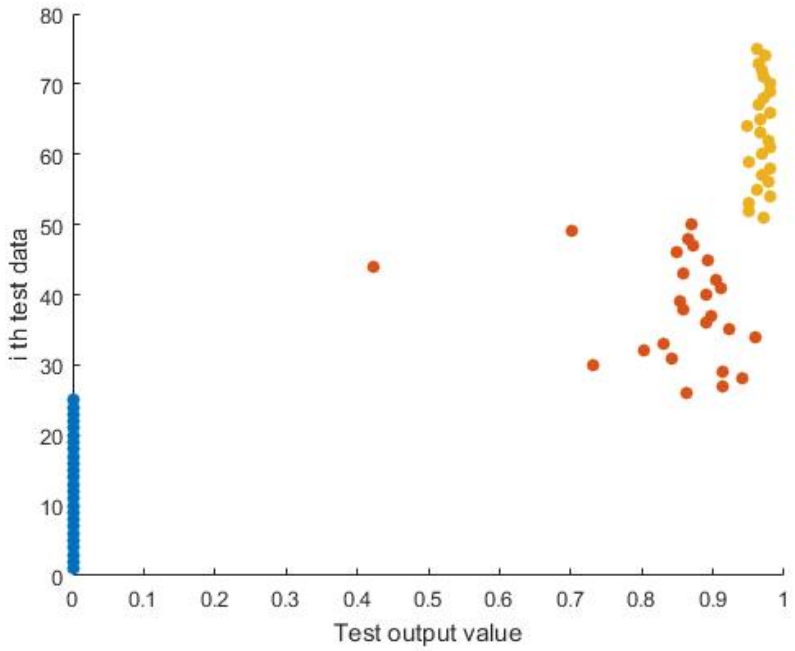

Figure 4 : Result of classification for 1000 epochs at Learning Rate = 0.7.

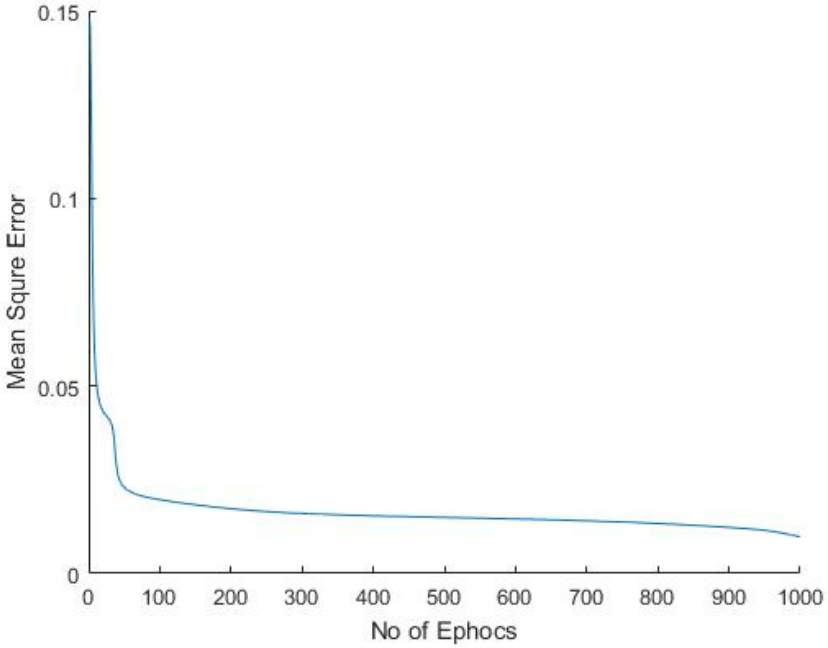

Figure 5 : For 1000 Epochs vs. Mean Squre Error at Learning Rate = 0.7.

IRIS Plant	Total	Classified	Not Classified
Setosa	25	25	0
Versicolor	25	3	22
Virginnica	25	19	6

Table 3.2: Test data classification for 1000 Epochs

3.3 No of ephocs = 5000

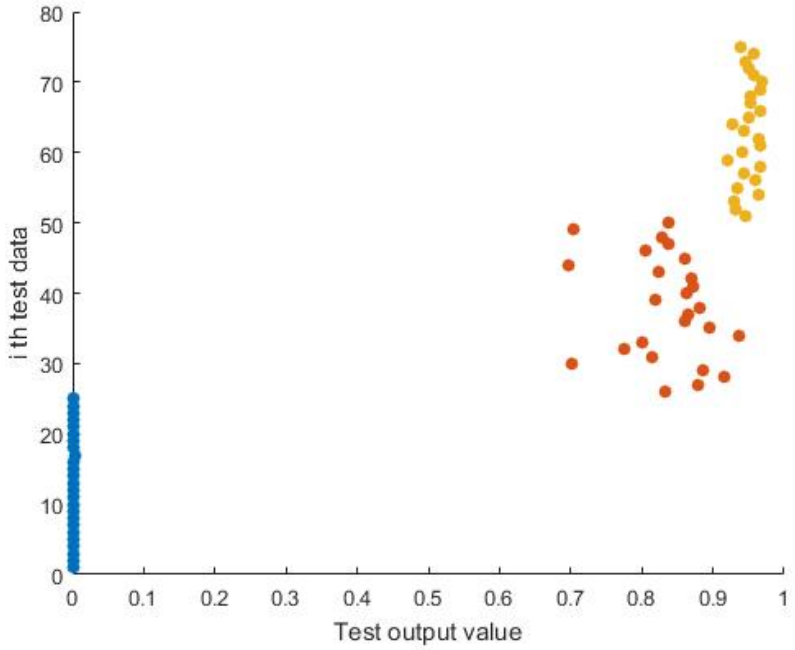

Figure6 : Result of classification for 5000 epochs at Learning Rate = 0.7.

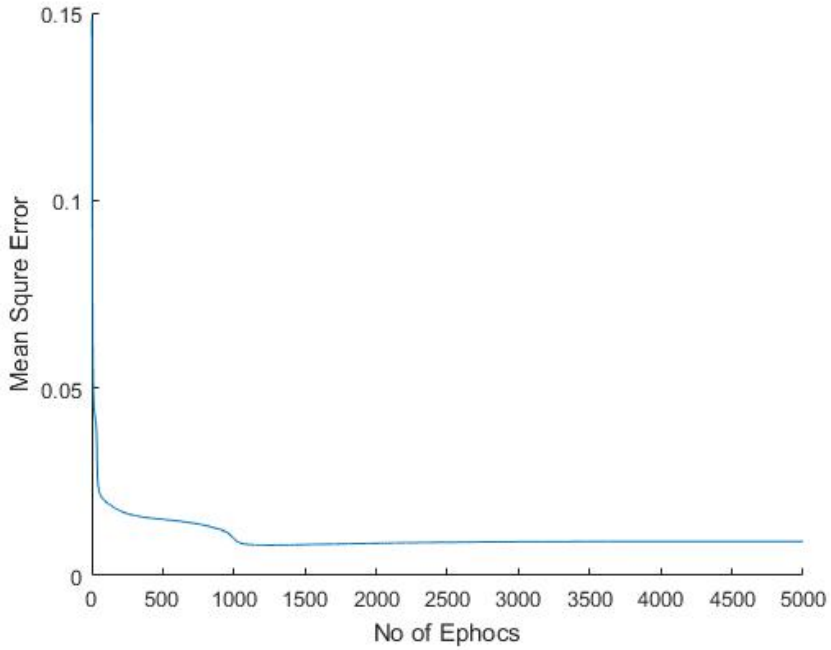

Figure 7 : For 5000 Epochs vs. Mean Squre Error at Learning Rate = 0.7.

IRIS Plant	Total	Classified	Not Classified
Setosa	25	25	0
Versicolor	25	3	22
Virginnica	25	21	4

Table 3.3: Test data classification for 500 Epochs

Chapter 4

Discussion

At the begining weighted all elements were initialized into zeros. But there Setosa class was not classified properly though number of iterations were increased.

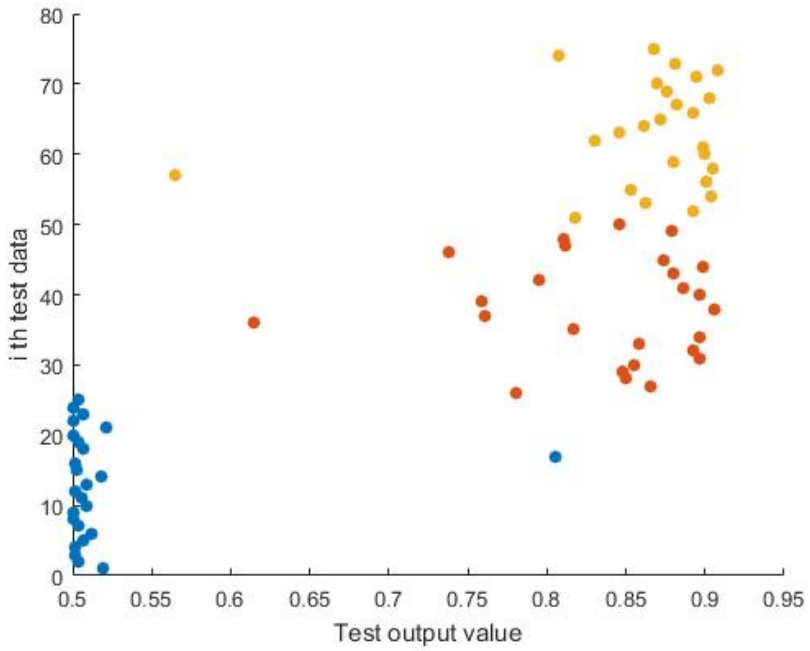

Figure 8 : Result of classification for 5000 epochs at Weights were initialized as zeros

Then weighs were initialized as follows .

$$w1 = \begin{pmatrix} 4 & -8 & -6 & 3 \\ 0 & -61 & 15 & -8 \\ -38 & -15 & 98 & 0 \end{pmatrix} \tag{4.1}$$

$$w2 = \begin{pmatrix} -25 & -12 & 5 \end{pmatrix} \tag{4.2}$$

After initialize weights in 500 iterations all 25 instances of Setosa class were classified, 4 instances out of 25 instances of Versicolor class were classified and 8 instances out of 25 instances in Viriginnica class were classified. Hence accuracy of that itrarions is 50.67%.

In 1000 iterations all 25 instances of Setosa class were classified, 3 instances out of 25 instances of Versicolor class were classified and 19 instances out of 25 instances in Viriginnica class were classified. Hence accuracy of that itrarions is 62.67%.

In 5000 iterations all 25 instances of Setosa class were classified, 3 instances out of 25 instances of Versicolor class were classified and 21 instances out of 25 instances in Viriginnica class were classified. Hence accuracy of that itrarions is 65.33%.

Chapter 5

Conclusion

The Multi Layer Feed Forward network does not give satisfactory result. Reason for that is when iterations were increased 500 t0 5000 then accuracy increased 50.67% to 65.63%. NN is said to be well performed when it accuracy is at least 80%. But this Neural Network accuracy is 65.33% at 5000 iterations also. Since this NN is not a well performed one. For proper classification will depend on proper initialization of weights.

Chapter 6

Appendices

6.1 MATLAB code used for implement the algorithm

```
clear all;
clc;

    %load training data
input = xlsread('Train.xlsx');

    %Normalization

    for a = 1:4
colmax = max(input(1:75,a:a));
colmin = min(input(1:75,a:a));
for b = 1:75
input(b,a) = (input(b,a)-colmin)/(colmax-colmin);
end
end

    %Backpropagation algorithm

    %initialize all vectors in the network
w1 = [4 -8 -6 3; 0 -61 15 -8; -38 -15 98 0];
w2 = [-25 -12 5 ];

    noEphocs = 500; %no of ephocs
meanSqureError = zeros([noEphocs:1]);
for ephoc = 1:noEphocs
SqureError = 0;
for notrainData = 1:75
p = input( notrainData:notrainData , 1:4);
p = p';
n1 = w1*p; %net input of the 1st layer
```

```
a1 = logsig(n1); %output of the Second layer
n2 = w2*a1; %net input of the second layer
a2 = logsig(n2); %output of the second layer
e = input(notrainData,5) - a2; %error of the final layer
SqureError = SqureError + e^2;

%considertollerence
if(abs(e) <= 0.01)
e = 0;
end

    %Back propagate the errors

    %calculations of error of each node
err2 = a2*(1-a2)*e; %error of the node in the output layer
f = [a1(1,1)*(1-a1(1,1)) 0 0;
0 a1(2,1)*(1-a1(2,1)) 0;
0 0 a1(3,1)*(1-a1(3,1))];
err1 = f*err2*w2'; %errors of nodes in the hidden layer

%calculations for weight updating
learningRate = 0.7;
deltaw2 = learningRate*err2*a1'; %weight increment of output layer
deltaw1 = learningRate*err1*p'; %weight increment of hidden layer

%updating weights

w1 = w1 + deltaw1;
w2 = w2 + deltaw2;
end
meanSqureError(ephoc,1) = SqureError/notrainData; %Calculte mean squre
error
end

%testing
testData = xlsread('Test.xlsx');

for a = 1:4
colmax = max(testData(1:75,a:a));
colmin = min(testData(1:75,a:a));
for b = 1:75
testData(b,a) = (testData(b,a)-colmin)/(colmax-colmin);
end
end
testOutput = zeros([75,1]);
for a = 1:75
p = testData(a, 1:4);
p = p';
n1 = w1*p;
a1 = logsig(n1);
```

```
n2 = w2*a1;
a2 = logsig(n2);
testOutput(a,1)= a2;
end

%plot Graphs
figure(1);
hold on;
scatter(testOutput(1:25,1),1:25,'filled');
scatter(testOutput(26:50,1),26:50,'filled');
scatter(testOutput(51:75,1),51:75,'filled');
xlabel('Test output value');
ylabel('i th test data')
hold off;
figure(2);
line(1:noEphocs , meanSqureError);
xlabel('No of Ephocs');
ylabel('Mean Squre Error');
```

Chapter 7

References

- Research Paper on AN APPROACH FOR IRIS PLANT CLASSIFICATION USING NEURAL NETWORK: https://http://airccse.org/journal/ijsc/papers/2112ijsc07.pdf
- Classification Advanced Method:https://learnit.itu.dk/pluginfile.php/162332/mod_resource/content/1/Bonus%20chapter%20on%20backpropagation.pdf
- Lecture Notes prepared by Mrs. M. K. A. Ariyaratne
- MATLAB: https://www.tutorialspoint.com/matlab/
- IRIS Data Set: https://archive.ics.uci.edu/ml/datasets/iris