

# Weather Forecasting with Back Propagation of Neural Network using MATLAB

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## ABSTRACT

Neural network is highly related with human brain. Back Propagation Algorithm is the best one to give the output with less error. So Back Propagation algorithm is used for analysis of Weather Forecasting for the month of one month with three sets of data. This paper explains the implementation of the Back propagation Algorithm tool. This paper also explains the graphical output obtained in the process with three data sets and one target data set. MATLAB R2012b is used for the simulation of process.

**Keywords :** Neural Network (NN), Fuzzy, Genetic Algorithm, Back Propagation Algorithm (BP), MATLAB, nntool, Data Training.

## I. INTRODUCTION

Weather forecasting is the most important of all fields. Weather forecasting plays vital role in fields like Agriculture, Transportation, Air Way Travels, and etcetera. Now a days it is easy to know the current weather report and it is important to predict and analyze the weather report for future. Agriculture is the main area mainly depended on weather and rainfalls now a days the agriculture has went in loss and the agriculture field is diminishing. And the weather tremendously increased hot in weather. By today there exists a number of ways to know the weather and we can also able to see the weather data for the upcoming days also. Weather report should be some knowledgeable to the users. So giving the weather data with most accurate or with less error will be more helpful for the user. There exists many ways to predicting the data for weather forecasting even for the next century. But applying the best method will give the best result.

Neural network deals with many areas and also in weather forecasting. Neural network clearly talks with the inputs, outputs and the sample data that are used. Neural network has a lots of algorithms to solve the different kinds of problems in different ways. Fuzzy also used to handle the data in a very easy set of fuzzy set instead of the crisp data. Fuzzy values can be easily

handled by labeling it with the corresponding labeling, for example the weather can be labeled as very hot, hot, moderate, cold, very cold. So handling the fuzzy data for training will also easier for the work.

MATLAB is a programming software used to solve mathematical problems and used in image processing. MATLAB also analyze the data to give outputs. Here MATLAB R2012b is used.

## II. METHODS AND MATERIAL

### 1. Literature Survey

Neural Network is an emerging field on today. It deals with the set of input and output data. Neural Network is mainly based on the concepts of human brain. We can easily choose any kind of data set through this. Because neural network is highly inter-connected in nature. And it can be stated neural networking is the best way to implement the analysis and prediction of weather data.

Neural network has a lots of algorithms like Back propagation algorithm, Radial basis function networking, General regression NN algorithm, fuzzy clustering etc. So we found that back propagation is the best algorithm among all the algorithm. Back propagation works based on the backward process.

This algorithm deals with the differential equations to solve the weights of each nodes. The algorithm has  $n$  inputs and one output the algorithm works in bottom up approach, to get the expected value in the correct way. Many analyses states that this algorithm is best among the others because this reduces the number of errors.

The weather forecasting with neural network can be done with any kind of front end works like programing languages like c, java. We can also use many software's to predict the data. But we choose MATLAB to execute the process. The analysis done by Jamshid Nazari and okan K.Ersoy states the comparison of MATLAB and other software's and they states that the MATLAB gives the best output than others and reduces the complexity of coding. MATLAB provides a tool for neural network which simplifies our work.

Fuzzy is a vast area which supports fuzzy values as inputs and outputs. The value taken as fuzzy is better than the working of values in crisp set. The collected data are converted to fuzzy using genetic algorithm with some selection methods, which provides best convergence values. Fuzzy is highly inter connected with neural networks.

The weather data are collected from the web site which gives correct values of weather data for old and upcoming years. In the older reviews they have collected the weather data for one year, ten years, and even they analyzed the weather data for hundreds of year. This shrinks the data set so I have planned to take the weather data for a month with different years. Which won't shrink the data like previous analysis. So the weather data is collected for the month of February, the month is chosen arbitrarily.

## 2. Proposed Work

The first task is collecting weather data for the month which we are going to analyze the weather forecasting report. I have collected three sets of data for the month of February for three consecutive years from the available webpage source. The data are stored for the further uses in a excel sheet. After collecting the data, data preprocessing is the main task which helps us to use the data without the missing of values and less errors. The weather data are in crisp set format are

converted to fuzzy set data with the process of fuzzyfication using the genetic algorithm method of random selection and the child are selected with the random selection technique. The MATLAB can be started to do the weather forecasting prediction analysis. Input data is the set of data we collected before and preprocessed data. Target data is the set of data which we created to obtain the expected result. Sample data is the data set which is randomly selected from the input data set. The input data, target data and sample data are loaded in the MATLAB in the workspace by adding new element for each. We have entered three sets of data with 29 elements in each set (3 sets of 29 data). If we enter the data vertically it will leads to a wrong prediction, because the data set will be taken as 29 sets of 3 data each. Now the "nntool" is used to train the data with the input data, target data, and sample data. Import the data into the tool using import option from the MATLAB workspace. Import the input data and the sample data variables as input and the target data variables as target. Imports has been successfully finished. Constructing the network is the most important work in the neural network. Network helps and it defines the number of layers in the process.

Create the network with the create option in the dialogue box. Select the network type as "Elman backprop", select the input data as input target data as target, select the training function as "TRAINGDX", adoption learning function as "LEARNGDM" define the number of layer as 1, and number of neurons as 10, and the training function is "LOGSIG" function. Elman backprop is used to train the data in back propagation algorithm manner. TRAINGDX is a network training function updates the weights and bias values according to the gradient descent momentum. LEARNGDM is gradient descent and bias learning function. LOGSIG is log sigmoid transfer function, calculates a layers output from its net input. Then create the network. The network will be as shown in figure 1.

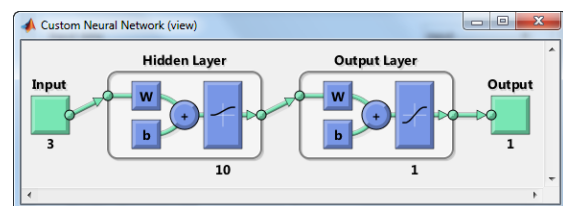


Figure 1. Network Diagram

The hidden layer is responsible for the weight calculation according to the gradient descent rule. Hidden layer is now visible to us, because the hidden layer is created by the tool itself for the errorless data training. In some other cases there exists looping in the hidden layer, which works again with the data if any error occurred in the previous data.

Training the data is the next step after construction of networks, network1 is selected for training the data from the Networks dialogue box. Training of data can be done by selecting the inputs as input data, targets as target data, training parameters can be adjusted according to our requirements, and train the data as shown in figure 2. The training of data will be shown in figure 3.

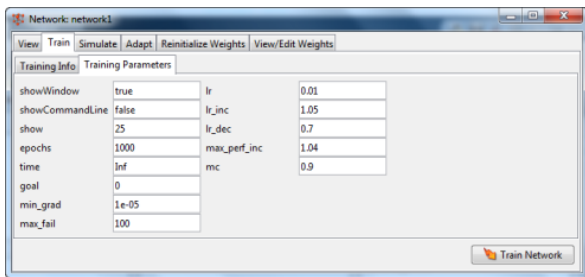


Figure 2. Data training settings

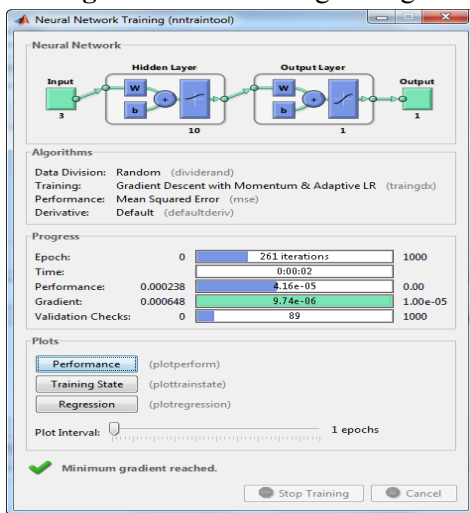


Figure 3. Training the data

Performance, Training State and Regression indicates the graphical outcome of the data training. They also give the performance of the data under training.

### III. RESULTS AND DISCUSSION

The results obtained from the training of data is graphically represented for each input data sets. The performance of the data gives the minimum number of error occurred in the process of training. The error

occurred between  $10^{-4}$  and  $10^{-5}$ . The best validation for the performance also found as  $2.8428e-05$  at epoch 0, and the maximum number of epoch occurred in this test data iteration is 255 as shown in figure 4.

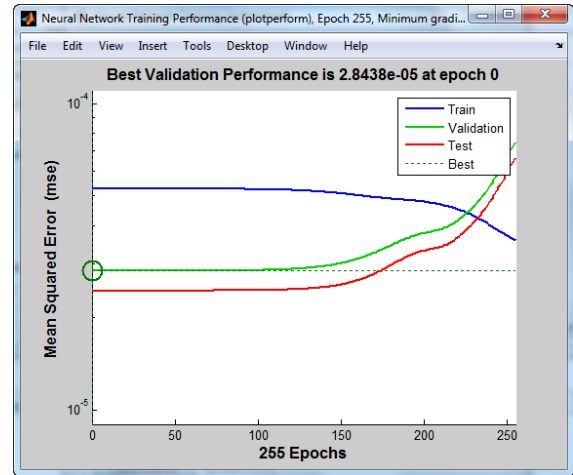
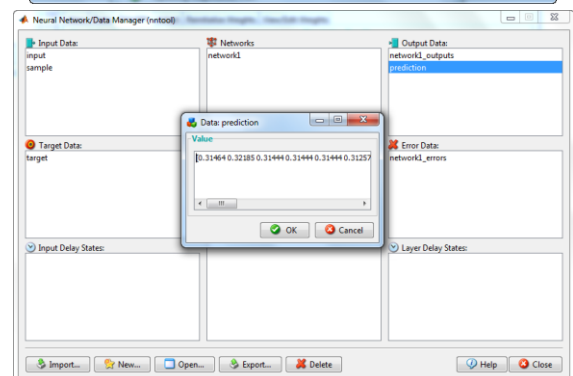
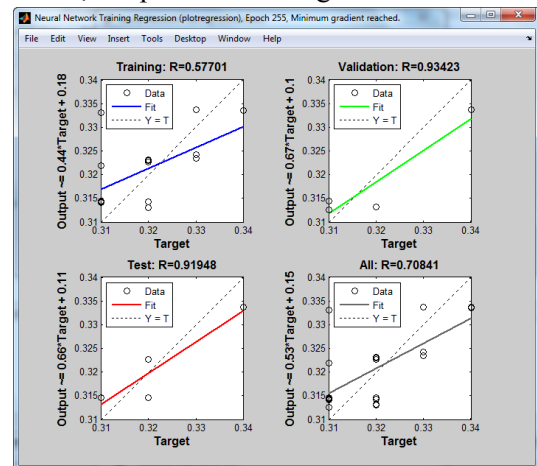


Figure 4. Best validation performance

Regression is an analytical process which explains the relationship between the variables. Regression of training, validation, best outfits are obtained. Prediction data set is obtained by simulating the network with input data.

Training  $R=0.57701$ ,  $Output \sim 0.44 * Target + 0.18$ ;  
 Validation  $R=0.93423$ ,  $Output \sim 0.67 * Target + 0.1$   
 Test  $R=0.91948$ ,  $Output \sim 0.66 * Target + 0.11$ ; All  
 $R=0.70841$ ,  $Output \sim 0.53 * Target + 0.15$



#### IV. CONCLUSION

The algorithm is Back propagation which reduces the level of the errors. The MATLAB is used to simulate the process using the neural network tool in MATLAB, which reduced the work load of coding and the data set are successfully trained without any errors. With the help of neural network we analyzed the weather data of February month and we can also conclude that the temperature of the month will gradually raise in future. The prediction values are nearly equal when compared with the input and target data. The number of iterations may vary in the other iterations of data training, but the less error value is obtained and they are constant.

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