International Journal of Trend in Research and Development, Volume 7(1), ISSN: 2394-9333
www.ijtrd.com

Optimization the Performance of Prediction the Thyroid Disorder Using FFNN with Optimization Technologies

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Abstract: Hospitals are reporting various sorts of thyroid disorder. In this paper, we used a big dataset which involves a test records of 2800 subjects along with the subject diagnoses. Machine learning approach such as Feed Forward Neural Network is used to learn over the data and hence to predict the subject diagnosis. Three techniques are developed over this study; namely: plain model, weight freezing model and Particle Swarm Algorithm model. The last model is outperformed as PSO algorithm is proven a noteworthy performance in optimizing the training process of the neural network. However, performance of this model is studied in terms of accuracy, MSE, MAE, RMSE and time and epochs. However, the Feed Forward Neural Network optimized by Particle Swarm Algorithm model is realized with optimum efficiency as prediction accuracy of 89.4 % is observed.

Keywords: - *ML, Metrics, Learning, Training, Testing, Accuracy.*

I. INTRODUCTION

As the other sources of wealth, big data is not behind the development line, it is used to support all technology and engineering sectors of today's life. For this reason, new science that keen on data analysis tools and techniques is established and known as data science.

This science is in continuous progress as data keep enlargement day by data so new tools and facilities might be required to tackle the data growth difficulties. As an example of growing data is the registry of birth and death, it witnesses new records on every day and hence data of this sector is quite big and need a special care [1].

The ways of data collection are differed where some data resources are just about people's entry such as highway traffic monitoring systems and birth-death registry systems. Other many organizations are kept their data for public uses with efforts to support research activity as main priority. The public data is usually not sensitive kind of data and made available to serve the public research sector and other types are kept confidential and need special approvals to be used in research [2].

The data science is that field which looks after developing the tools and methods to deal with data, the main disciplines of this science is data clustering, data prediction and data classification.

Too many tools are developed to support this field such as classification algorithms and optimization tools. Data science is further developed after introducing of machine learning tools and the popularity of the machine learning in new program languages such as pythons. Machine learning toolbox is further integrated.

At [6], speech recognition is newly developed area of research that aims to intake speech signal and convert the speech utterance into texts or into forms understood by the machines (computers). The speech recognition system is involving a language model which is basically attempts to correct the detected words into the right utterance. Speech recognition system is directly impacted by indoor or outdoor noise which is caused basically by other voice resources at the speaker's vicinity. Neural network is used to construct the language model by providing the prediction services of the next possible utterance in speck series words. Probability roles and artificial neural network can be combined together to establish speech recognition system with high performance. Speaker model is made by participation of large number of vocabularies that feed to the neural network as known sequence, the neural network is in turn trained to predict the same sequence at the time of testing. In this paper, 2800 thyroid patients are used with FFNN algorithm to train the machine for predicting the thyroid disorder.

II. DATASET DESCRIPTION

The data are gathered from online source which represent the battery of tests for thyroid disorder diagnosis. This dataset is publicly available freely for research activity, it consists the records of 2800 patients. There are twenty-seven column in the dataset every column stands for some biological test of the patient such as age, gender and rest are medical examinations for blood and urine.

Table 1. Target encoding and class description.

Class	Code
Positive	0
Negative	1
Hyperthyroid	2
T3 toxic	3
Goitre	4

One column in the dataset is representing the code of the patient which will be negligible while processing as it is not involved in any decision making or disease diagnosis.

All the 2800 records are being diagnosed in the hospital by specialist doctors and the decisions of diagnoses are made as in Table 1. this column is an important part of the dataset which represent the target and will be essentially used while mining the data. The classes realized in the target are five namely: hyper thyroid, positive, negative, t3 toxic and goitre.

III. PREPROCESSING

Figure 2 is demonstrating the process of data encoding which is about converting the data into logical format to enhance the training quality.

Table 1. Dataset cells encoding and conditions.

Cell value (condition)	Code
If cell value is "male"	Return 0
If cell value is "female"	Return 1

If cell value is "true" or is "t"	Return 1
If cell value is "false" or is "f"	Return 0
If cell value is "p"	Return 1
If cell value is "N"	Return 0

One of the most important steps in this process is ignoring the columns that not having any impact in decision making such as patient/s name, address or any other similar information. Such information might increase the load on the machine without any benefit in the decision making.

The other step in pre-processing is the condition awareness which imply what is the suitable value to be replaced in place of the cell in order to convert it into logical format. Table 2 is demonstrating the condition of all the columns. The process of coding the data cells is depicted in Figure 1.

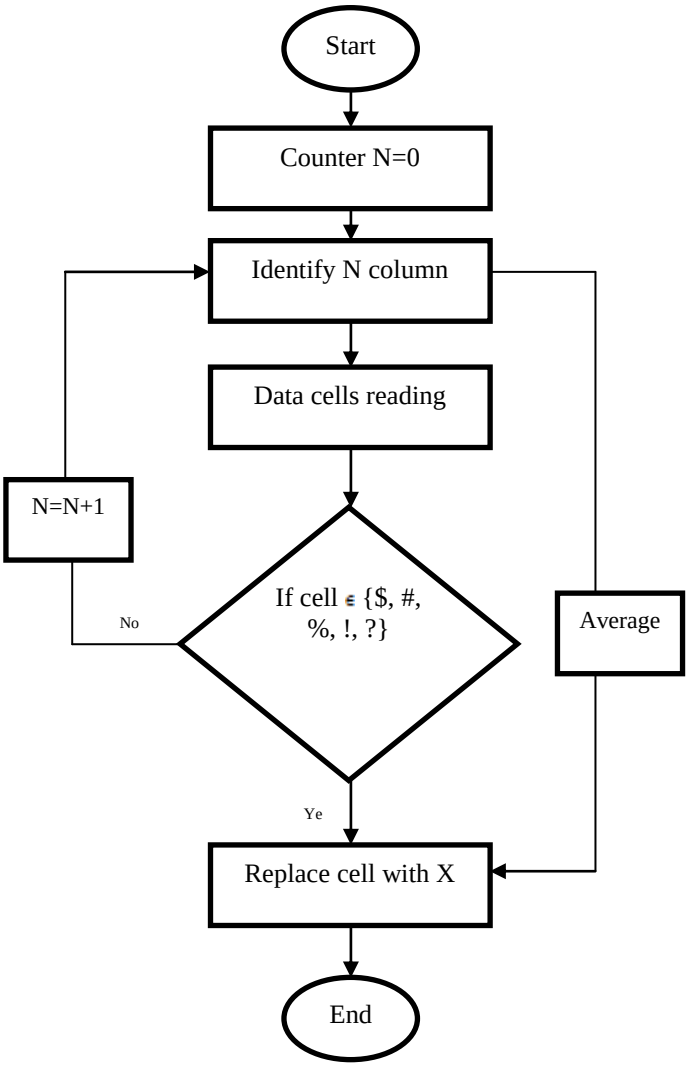

Figure 1: Missing values processing program

IV. FFNN

Feed forward neural network is one of the deep learning tools that can be used efficiently for prediction or classification of data in one direction alike process. as the name indicates it does not include a feedback processing and hence no impact of the current decision on the next or further decision [11].

The common of processing is multilayer configuration that involves three layers namely one input layer, one hidden layer and one output layer. Layers are constructed of neurons that exists in each layer and connected with other layers neurons.

Weights and biases are other terminologies in neural network, these things are very important for the neural network decision making process. the weights are connecting the neurons of each layer with the neurons in the next layer. Neural network general structure is demonstrated in Figure 2.

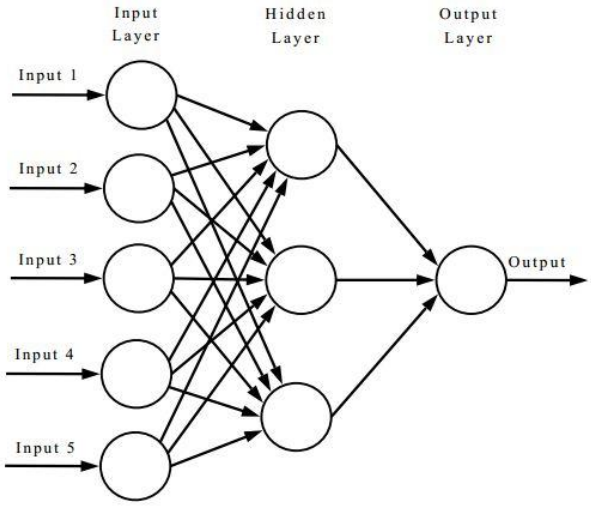

Figure 2. Layers structure of neural network.

The model parameters are detailed in Table 3.

Table 2. FFNN settings parameters.

Parameter	Value
Number of hidden layers	1
Number of output layers	1
Number of input layers	1
Learning tool	LM
Fitness function	MSE
Maximum target performance	1 e-100

Experimental model

For first instance, feed forward neural network is implemented as per the aforementioned data and the first implementation was done to monitor the performance for the above network. The network is trained for 50 times and in each training the performance was recorded.

Secondly, model freezing which involves weight vectors from the previous experiment are obtained and then each is analyzed with efforts to know its influence on the performance. Each weight vector is applied to the model and the performance is measured. Machine is set to choose the weight vector that yields the minimum error and best performance.

Eventually, further work was performed by employing PSO algorithm instead of LM. This is actually performed for the purpose of generating a set of weight vectors and discovering which one will yield the best performance and minimize the error at the predictions.

V. RESULTS AND DISCUSSION

In every algorithm, performance metrics namely: Mean Square Error, Root Mean Square Error, Time, epochs and Accuracy are obtained and the same is represented graphically as following.

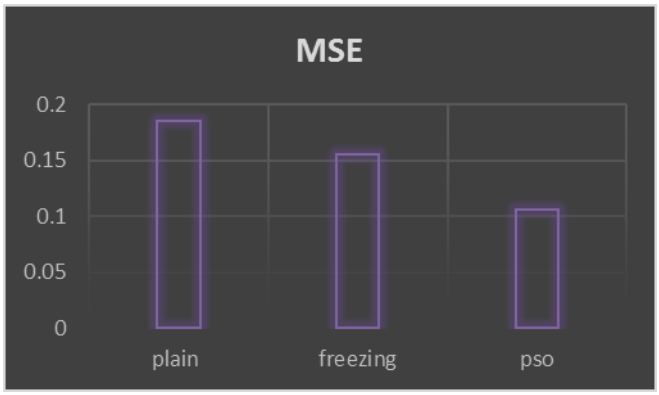

Figure 3. MSE demonstration of all the tools used in the study.

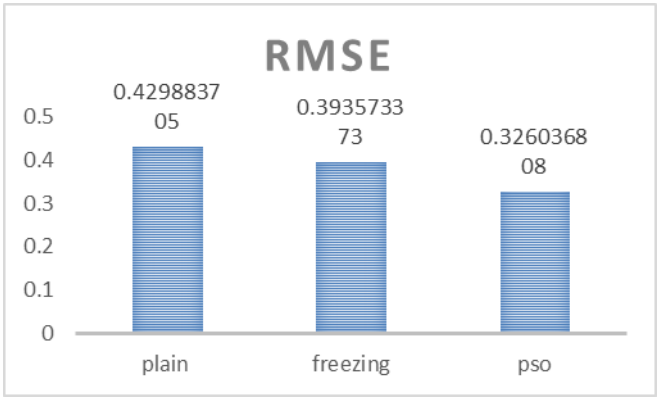

Figure 4. RMSE demonstration of all the tools used in the study.

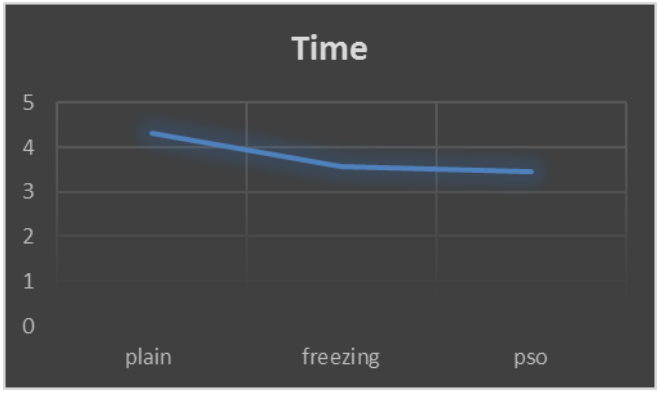

Figure 5. Time demonstration of all the tools used in the study.

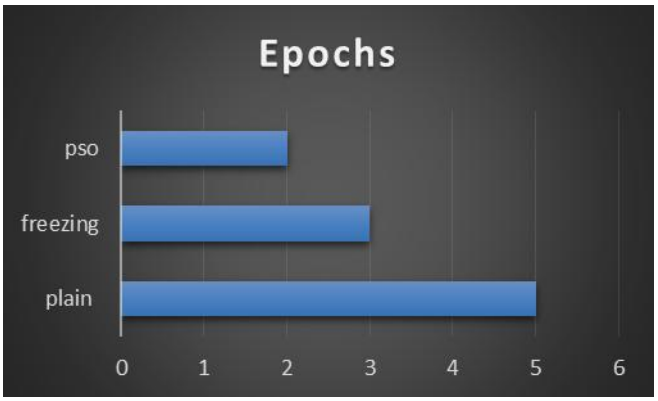

Figure 6. Epochs demonstration of all the tools used in the study.

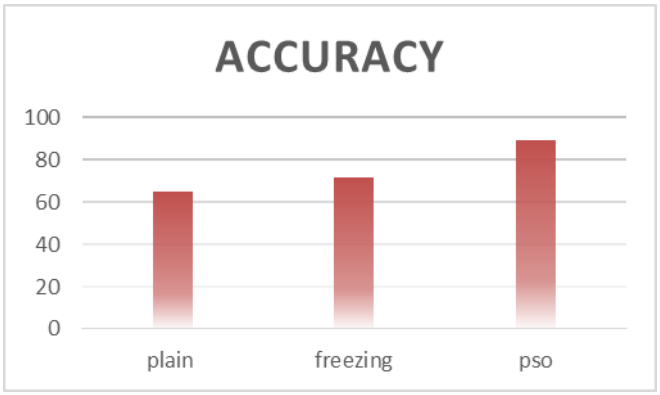

Figure 7. Accuracy demonstration of all the tools used in the study.

CONCLUSION

Firstly, neural network is realized after a hundred iteration of training and results are recorded after ending of each iteration. Hereinafter, weight freezing technology was used which made the results equal to the best among the previous hundred iteration be setting the weight that yields the best performance. Eventually, particle swarm algorithm is used to guess the weight coefficients and hence the performance is recoded and set for comparison. Performance of those models is studied in terms of accuracy, MSE, MAE, RMSE and time and epochs. The results are shown that long short term memory neural network is outperformed in thyroid data prediction over the other tools. The same is confirmed by referring the other performance metrics such as time and mean square error as lesser of both metrics are realized in case of Feed Forward neural network which yielded MSE, Time, Accuracy, Epochs and RMSE equal to 0.1063, 3.465, 89.4, 2 and 0.32603681 respectively.

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