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Performance analysis of ADALINE and MADALINE Network in classification of Thyroid Disease

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Abstract— **Artificial Neural Network (ANN) is an information processing model that motivates by biological nervous system. The applications execute the process similar to human brain work process. Various applications implement the artificial neural network work to achieve the optimal solution. The neural networks have good scope in the medical data analysis. Diagnosis is one of the major aspects in the clinical trials. Various methods involve into diagnose the disease accurately. Many of the diseases have many stages and metric of diagnosis value differs from one stage to another stage. Hence the classification process should be needed to classify the stage of disease; more classification methods bring the required result in disease classification. Especially, ANN processing model attains the accuracy of classification. In this paper, work engages to analysis the performance of the classification of hypo thyroid disease types in Adaline and Madaline networks, the results shows the Madaline networks reach the accuracy level better than Adaline networks.**

Keywords— **Artificial Neural Network (ANN) classification, Classification, Madaline, Adaline.**

I. INTRODUCTION

Exact prediction of the thyroid gland is essential for the diagnosis of thyroid disease. It is mainly responsible for managing and controlling the metabolism. Purpose of thyroid is very important on every parts of the body[7]. This gland secretes two types of hormones levothyroxine (abbreviated T4) and triodothyronine (abbreviated T3). These hormones are producing proteins; maintain the stability of body temperature and energy preservation. There are two types of thyroid disease. First one is a common thyroid disorder that is called hypothyroidism. Thyroid gland does not secrete needed hormone less count. Sometime gland secretes more hormones that are called hyperthyroidism. Woman and aged people affected by the thyroid gland disorder. Groups most commonly affected by the disorder include women and elderly people. The clinical and laboratory based diagnosis leads to underestimated the risk of hyperthyroidism and lead to dangerous situation in several cases. The thyroid type does not have a definite position of thyroid symptoms and clinical trials are difficult to assure the correct diagnosis of malfunction through clinical test. The symptoms of hyperthyroidism are such as lethargy, confusion, weight gain and poor memory .Even the laboratory test classify the disease, and it is not give agreeable result in all situations. Artificial neural network is one the best processing model for classification and pattern recognition [9]. They have been used in diagnosis of many different problems like heart diseases, diabetes and thyroid dysfunctioning. The ANN produces efficient results on pattern recognition, and classification [4][12]. The characteristics of data identify the features of data through learning process. Usually, the training data used to training the sample and test data is used to estimate the predictive. The estimated classification rate can be quite different from the true classification rate particularly when small sized samples are used. The cross validation used to predict the performance of neural network a resampling technique [5].

II. ADALINE NETWORK

A neural network is a processing model whose design motive by human brain, every neuron interacts each other and transfer the Information between them where knowledge is not stored in the individual nodes, but rather it is represented by the weights of the connections between the nodes.

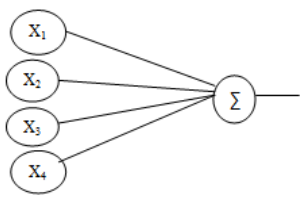

Fig. 1Adaptive linear network

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Adaline (Adaptive Linear Neuron) is simple linear model two layer neural network. One layer refers to input and another layer refers to output layer which having a single output neuron [6]. All input neurons send the data to single output neuron. The function of all linear model neurons transfer (y = kx+n), and network exercise the result with Least Mean Squares (LMS) algorithm for learning. The scopes of Adaline network are recognizing patterns, data filtering, or to approximate linear function.

Calculate the net input to the output unit y

$$y_{in} = b+\sum_{i=1}^{n} x_i w_i$$

Update the weights $w_i$and bias b_i for i=1 to n

$$w_i \text{ (new)} = w_i\text{(old)} + \alpha(t - y_{in})\ x_i$$

$$b_i \text{ (new)} = b\text{(old)} + \alpha(t - y_{in})$$

Here‘t’ represent the target value. Apply the activation function over the net input calculated

$$y = \begin{cases} 1 \ if yin > 0 \\ -1 \ if yin < 0 \end{cases}$$

In adaline neural network, the learning process held by the adjustment of the weights of the neurons as per the weighted summation of the net inputs. Each neuron in the adaline neural network accepts more than one input but generates one single output.

III. Madaline Network

The multiple adaptive linear neurons model consists of many Adalines in parallel with a single output unit whose value is based on certain selection rules. It may use majority vote rule [6].

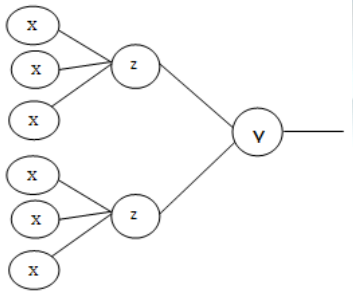

Fig. 2 Madaline Network

The weights that are connected from the Adaline to Madaline layer are fixed positive and possess equal values. The training process of the Madaline system is same as that of an Adaline.

Calculate the net input to each hidden Adaline unit

$$z_{in} = b+\sum_{i=1}^{n} x_i w_{ij} \quad \text{where j= 1 to m}$$

Calculate output of each hidden unit

$$z_i = f(z_{inj})$$

Find the output of the net

$$y_{in} = b_0 + \sum_j z_i v_i$$

Calculate the error and update weight

$$w_i \text{ (new)} = w_i\text{(old)} + \alpha(t - z_{inj})\ x_i$$

$$b_i \text{ (new)} = b\text{(old)} + \alpha(t - z_{inj})$$

IV. Dataset Description

The thyroid gland absorbs the iodine from the food and secretes the Triiodothyronine,Tetraiodothyronine hormones. These two hormones maintain the metabolism of the body and regulate the production of protein. Thyroid Stimulating Hormone (TSH) mutate the thyroid glands for secreting the hormones T3 and T4. Pituitary gland produces the TSH. The metric value of FTI (Free Thyroxine Index) estimates the level thyroxine sectretion[2]. The type of hypothyroid disease based on its attributes is classified in following table.

TABLE I
Classification of Hypothyroid Disease

Types of Hypo thyroid disease	TSH	T3	T4	TT4	T4U
Primary hypo	H	H	L	H	H
Secondary Hypo	H	L	L	L	H
Compensated Hypo	L	L	L	L	L

The Levenberg-Marquardt (LM) algorithm is the common training method for minimization of MSE (Mean Square Error) criteria, due to its rapid convergence properties and robustness[11]. The LM algorithm is first shown to be a blend of vanilla gradient descent and Gaussian Newton iteration. This error back propagation algorithm is used to calculate the weights updates in each layer of the network. If the MSE value increase, the accuracy of classification will be mislead. The minimal of MSE value exploits the finest accuracy classification.

V. Performance of Adaline Network

The primary aim of developing an ANN is to generalize the features (there are 24 inputs are given in the input nodes of the neural networks) of the processed outputs. We have applied various numbers of neurons for minimizing the MSE value. The weight value of input layer, output layer and hidden layer are trained with Hebb rule to decrease the squre root to zero.

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The simulations were launched by Neural Simulator 4.0 of Matlab v.7.0 [10]. The number of hiddern neurons is progressively increased from its initial value. The minimal numbers of hidden neurons reach the smallest MSE value in training process. After training process, the table 2 shows the MSE value in different architecture.

TABLE II
PERFORMANCE ESTIMATION OF ADALINE NETWORK

Architecture	Train MSE value
18-18-1	0.035491
24-8-1	0.14017
5-5-1	0.0222
8-2-1	0.3333
28-1-1	0.31772

VI. PERFORMANCE OF MADALINE NETWORK

The Madaline neural network is also used for classification,function approximation, pattern classification and recognition. In Madaline, multi Adaline networks consolidate the outputs and pass the value into net output unit. The output of each Adaline network acts as hidden unit of Madaline network. The input parameters pass in to Madaline network which has given to evaluate the Adaline network that the same parameters have also feed in to the training process of Madaline network. The number of hidden units decides the value of MSE. After training process the table 3 shows the MSE value in various architecture.

TABLE III
PERFORMANCE ESTIMATION OF MADALINE NETWORK

Architecture	Train MSE value
18-18-1	0.033391
24-8-1	0.09407
5-5-1	0.0192
8-2-1	0.3432
28-1-1	0.31778

VII. PERFORMANCE EVALUATION

The main objective of this paper is to analysis the performance of Adaline and Madaline Network with modification of hidden neurons and to achieve the accuracy of classification. The table 2 it is observed that the Adaline neural network classification is working perfectly in TSH classification and MSE value has minimized than other types of hypothyroid classification in 5-5-1 architecture. In Table 3, it is observed that the Madaline neural network classification the MSE value is less than the MSE value of Adaline network.

VIII. CONCLUSIONS

Art of disease classification is the scope of the artificial neural network. In this paper, Adaline network and Madaline networks involve to classify the types of hypothyroid and evaluate the performance in different architecture. The evaluation of MSE results shows the performance of Madaline network better than Adaline network. In future, research will be enhanced for predicting the disease with the implementation of various network architectures.

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