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REVIEW ARTICLE

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Artificial Neuron Learning Technique in Soft Computing: A Review

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Abstract: This paper is based upon the learning of artificial neurons with respect to supervised and unsupervised learning algorithms. To maintain the strength of neurons, we must update the weights such that neurons can reach up to threshold value for spiking. Neural Network can update by examples given to the system. There are three types of learning:- Supervised Learning, Unsupervised Learning and Reinforcement Learning. All the learning methods having a neural network pattern differ in solving the inputs according to the application.

I. INTRODUCTION TO NEURAL NETWORKS

Neural network connection actually resembles the concept of biological neuron. The Biological neuron receives the information from the dendrites in which neurons are transferred through synapse. The connection between one neuron to another will be connected with respect to axon. The signal of the neuron will be differentiate among each other according to multi neuron approach. Human Brain consists of approximate 10^{12} neurons that can communicate with each other through electrical signals in the form of spikes [1][2]. Neurons receive signals through cell body form other neurons which will be integrated them together to transfer that signal via axon. An Artificial Neural network consists of multi-processing elements with suitable bias and weight values which can learn with respect to time and it should be trained for better performance. Synapses are simulated through weights of the neuron which should be combined together with bias value. We must apply activation function to compute the final output. So, we can say that an artificial neural network having similar approach as the working of human brain [2]. The processing of these neurons will be worked in the form of each and every weight of the neuron that will be trained or update as new input occurs. We can apply different types of activation functions as per as the requirement of the data set. Various types of sigmoid functions, transfer functions are available to compute the output in the form of radial basis function especially for the multi-layer perceptron model which can reduce the error at each and every iteration or epoch. The output might differ according to the number of hidden layers used in that algorithm along with various types of parameters like training set samples, learning rate, activation functions etc [3]. If we want to reduce the number of hidden layers, we must work on training samples and apply suitable bias and weight valued to reach the global minimum value. So, we can say that output accuracy will be the biggest hurdle in the field of artificial neural approach.

II. TYPES OF LEARNING

Supervised learning: Supervised learning is a technique used to update their weights of neurons at various training processes. In can only be train by previous stored examples in the database. An external teacher provides the network with a set of input through which the desired output is known[4]. At each training level it will check with desired output according to the requirement which is based upon addition or subtraction of weight's value to reach the desired output. To change it, we must require some supervised algorithm for updation of weights.

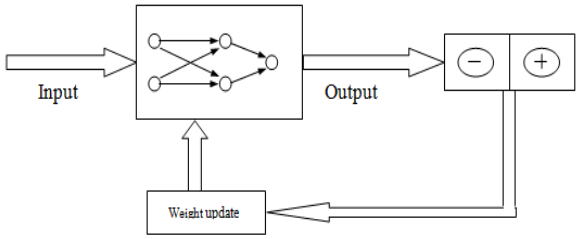

Figure: Supervision with Back Tracking

The input consists of all the weight and bias values of neuron, which will provide a specific output. At this stage, we must require a target vector which can recognize whether the output is correct or not. If the output is correct then allocate the final weights to the neuron & stored in database. If not, so apply any supervised learning algorithm like Adaline, Madaline, Perceptron, and Back Propagation for updation in weights according to the previous value[5]. In this way, supervised training process will work from the example stored in the database.

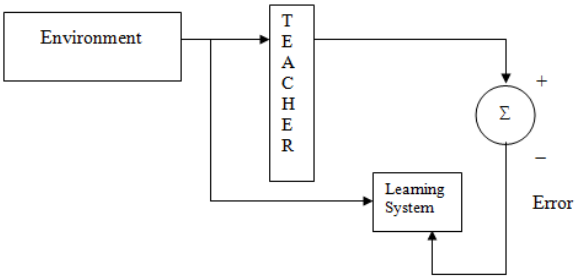

Figure: Working of Learning System

Environment refers to all basic requirements of the application. It is given to the learning system to produce an output. If actual response occurs; weights can be stored; else teacher would identify error. Teacher is like an expert

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system which identifies the fault within the network and order instruction to learning system to update their weights with respect to any algorithmic technique. Suppose that we are having software which can identify a disease of a person. It is based upon some rules previously stored in the database. According to the blood cells of the human being it will check the condition by comparing each rule with the input data. If any match occurs, it will display the disease of that person else no disease according to the input. We may require additional rules to be added if requirement occurs[3]. Machine learning is based upon the experience just as human learning exists. A computer doesn't have any experience but learns from previous data which represents some past experience of the application. Supervised learning consists of two parts:- Training and Testing. We can compute the accuracy by first creating the network table and then apply a suitable algorithm to it and then create a model which describes the learning criteria. After getting a suitable model, teacher must check with testing conditions i.e. either white box testing or black box testing to predict the output value.

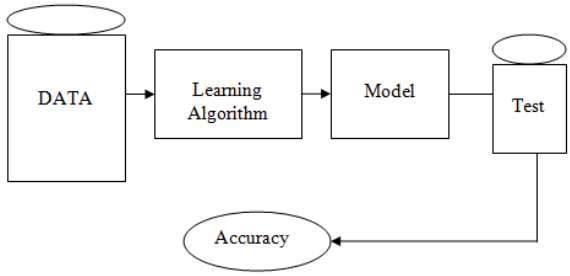

Figure: Testing Criteria over Network

Supervised Learning must require learning step at each stage to predict the final accurate value. If the model is of incorrect nature then it will produce wrong results according to the input data. Supervised learning is widely used in pattern recognization, approximation and identification[5]. For Example: - Ball, Ellipse, Circle having similar characteristics but different curvature i.e. we have to identify a particular feature for extraction.

Unsupervised learning: Unsupervised learning is a technique which can compute the value without any teacher. E.g.:- Bisectional Method is a method which can solve to find out the roots of any equation until we get the similar value from the above iterations i.e. we depend upon the previous iteration not with the desired output.

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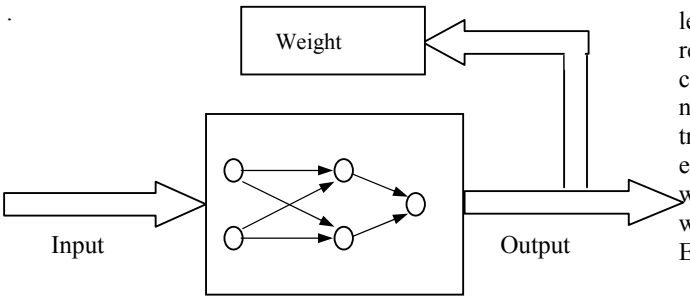

Figure: Unsupervised Technique with Specific Output

In this technique no desired output will be required as target vector in supervised learning. It is also called self-organizing learning technique. Data is in the form of clusters with similar values according to the requirement of the application. It is also called open loop adaptation learning for a function which can call itself again and again until the same previous value occurs. The various training algorithms like Kohonen algorithm are self-organization map, counter propagation network and adaptive resonance theory for the calculation of unsupervised learning[7]. We must require criteria to terminate any type of example because there is no termination condition in unsupervised learning. It can only learn from the previous examples that are stored in the database whereas in supervised learning it can learn from environment and examples with respect to rules stored in the network. We can't conclude the output because there is no desired value to identify the target factor. Every time it will update their weights according to previous iteration value. So, if the output is incorrect, then the whole process will be lost.

Re-Inforcement Learning: It is also called graded learning for extension of supervised learning in which we can update their weights according to external parameters just like Madaline. We have to attach external reinforcement cells to reach the desired output quickly.

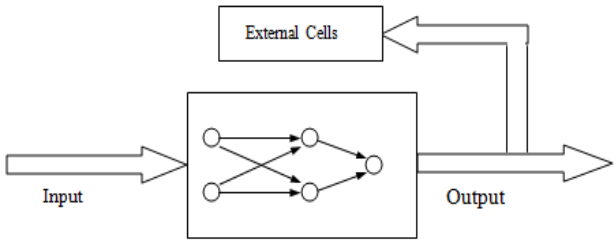

Figure: External Cells with Specific Output

It can be computed as auto associative learning i.e. mapping pattern to pattern. It is just like same layer technique whereas Hetro association consists of different neurons of dissimilar nature. That's why reinforcement cells must be required for the conversion of one cell to another[6]. It is also called intermediate form of two types of learning. It takes action & gets a feedback response to environment which is based upon expert system about desired output. It is a special case of supervised learning. It checks whether the actual output is close to estimate or not. Every time it predicts the future value about the desired response of the system. If estimation value true then retransmitted the data back to the learning system to evaluate the new output. If not so, external reinforcement cells must be attached to meet with the desired response. Learning system which can learn on example feedback to environment for attach reinforcement cell at the hidden layer. It is only use when correct output for input patterns is not available & there is need for developing the output. The evaluation of output true/false depends upon the specific problem according to environment structure. One of the methods for finding the winner neuron by using Euclidean distance between the weight vectors among them. The unit with the smallest Euclidean from the input vector as a winner.

III. IMPLEMENTATION BY LEARNING ALGORITHM

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Madaline are many Adalines that combines together to generate a larger structure called MADALINE just like MS-OFFICE acts as a MADALINE and MS-WORD, MS-EXCEL, MS-POWER POINT, MS-ACCESS are the Adalines features to generate a large structure. By doing it, we will reduce the iteration because of integrated all the error value back to the original bias and weights. In this approach, every weight factor lies upon one neuron to another i.e. Wij where 'i' is the sender neuron & 'j' is the receiving neuron. Every factor of adaline combines into a larger group that acts as a hidden layer between the two outputs. It can be connected according to the feed forward network having a direct link from each & every neuron. It can be also given an external input at the middle layer to reduce the error at each level.

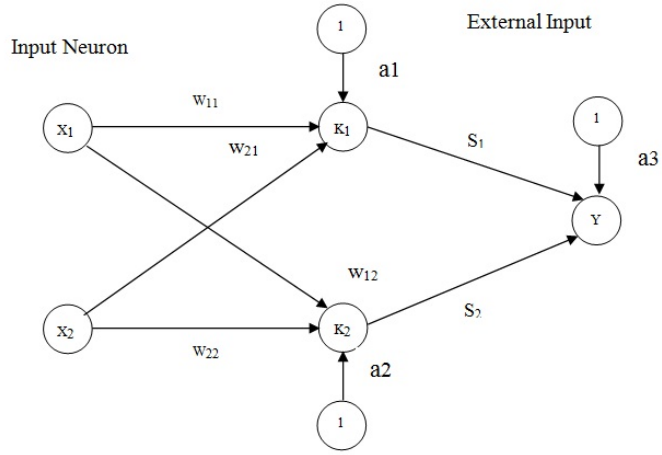

Figure: Madaline Structure through Learning

By combining multiple adaline networks, we can generate a large structure i.e. Madaline structure to fulfill a value for further movement of one neuron to another. In the above diagram a_1, a_2, a_3 are the external inputs applied to the neurons for reducing the error value with faster response according to the iterations. Weights can be updated according to the previous value as well as combining with external inputs to generate a large structure.

ALGORITHM:-

- Initialize weights w_{11}, w_{12}, w_{21}, w_{22}, S_1, S_2.
- Input all the bias value of each & every neuron like x_1, x_2 according to the N/W.
- Computer the hidden layer adaline i.e.
  - $k_1 = a_1 + x_1 w_{11} + x_2 w_{21}$
  - $k_2 = a_2 + x_1 w_{12} + x_2 w_{22}$
- Determine the value of output function according to adaline input.
- Calculate the next layer adaline i.e.
  - $y = k_1 s_1 + k_2 s_2 + a_3$
- If y is +ve, then w_{11}, w_{12}, w_{21}, w_{22}, S_1, S_2 remains same for that network and exit else
  - $w_{11} = w_{11} + \eta\, x_1(t\text{-}d)$
  - $w_{21} = w_{21} + \eta\, x_2(t\text{-}d)$
  - $w_{12} = w_{12} + \eta\, x_1(t\text{-}d)$
  - $w_{22} = w_{22} + \eta\, x_2(t\text{-}d)$
- Go to step 3
- If y is –ve then Stop.

IV. REAL LIFE APPLICATIONS OF LEARNING

- **Robotics: -** Due to the increase in modeling & control complexities of the robotic system, there has been a strong trends in applying tools of connectionist modeling of Neural Network. It is the learning capability of Artificial Neural Network coupled with parallel processing & generalization capabilities that made possible the successful application of Artificial Neural Network in the control of robotic system.
- **Stock-Market Prediction:** -The day-to-day business of the stock- market is extremely complicated. Many weight factors about a given stock will go up or down on a given day. Neural Network can examine a lot of information quickly & sort it all out; they can be used to predict stock prices.
- **Medicine: -** Neural Network has been used for identify a particular disease as well as produce output i.e. medicine name for that problem. Strong medical records based on previous case information.
- **Machine Learning: -** Computer can understand only according to the instruction given to it .But with the help of stored examples of Neural Network, it can learn & produce output of new problems. So it is basis on Machine learning criteria
- **Oil Exploration: -** Though vector processing, Neural Network can exploratory a new oil mine according the distance between oil explorers. It also depends upon external parameters about the environment.
- **Weather Forecasting**: - Through Neural Network using feed forward technique it can predict the weather by using various parameters like humidity, visibility etc.
- **Aircraft Controller: -** Through Neural Network, it can resolve the movement of aircrafts by controlling speed, velocity & direction of the device at various levels.
- **Braking Car System**: - Neural Network can enhance the feature by braking car system in which the speed of the car decreases as any obstacle come in way. It is based on recurrent network about the speed of the vehicle for braking control
- **Simulation: -** Simulation is an important application of Neural Network for creating similar characteristics as of actual machine of multiple devices. By using CAD, we can create the model of automobiles as well as other.
- **Diagnosing Heart Attack: -** It is based on electric cardiogram for diagnosing any problem of Heart, It provides us detail information about any problem if exist.

V. CONCLUSION

This paper discussed about the artificial neural network, its working along with training phases of an Artificial Neural Network through different types of learning. There are various advantages of Artificial Neural Network over conventional approaches. Today, neural networks

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discussions are occurring everywhere specially in the term of recognition of a character or numeric values. The learning approach is commonly used in fingerprint detection, visual detection, bank cheque, microphone records etc [5]. The good solutions reproduce to form new and hopefully better solutions in the population, while the bad solutions are removed. Currently most neural network development is simply proving that the principal works.

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