



# DESIGN EVALUATION OF ANN CLASSIFIER LAYERS IN COGNITIVE RADIO NETWORK

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## ABSTRACT

The classification of the system falls under two broad categories: supervised and unsupervised learning. Unsupervised learning is used when there is no class data available for a dataset. In this case objects are partitioned so as to cluster the data in an efficient manner. Supervised learning is used in situations where there is some sample data available with appropriate decisions that can be used as a training set. Classifiers often operate in two phases; training and testing. In the former one, the relationship between the extracted features and the classes are determined and optimized.

In the later stage, the given data is classified by the use of training data. The training phase is computationally intensive and longer than testing phase. In a classification routine, feature vector is the most important component which represents or describes the given object by the use of a numerical quantity. Hence, the choice of feature vector is closely related to the success of any classification system. In general, the classification system compares the feature vector of a test object with training objects.

Therefore, if the feature vector of training objects is not appropriate, then misclassification will occur. The initial choice of a feature vector is not the best one. Some features may not contribute to the classification task or might be made redundant by other features. The attempt to classify with these features can not only increase the computation time significantly, but can make classifications less accurate. In order to mitigate this problem, a feature reduction step should take place. A good feature reduction process will result in faster

learning due to less data, higher accuracy and better generalization to other data sets.

**Keywords:** ANN, Perceptrons and NN.

## 1. INTRODUCTION

In a recognition or classification system, the selection of appropriate classifier is very important as it may change the course of the entire output of the system. In recent years the classification by neural network has been increased as it acts as an alternative to the different conventional classification methods. In the year 1943, two persons called as McCulloch and Pitts has described the brain functions by means of a mathematical model and used their neural networks operation to model the logical operators.

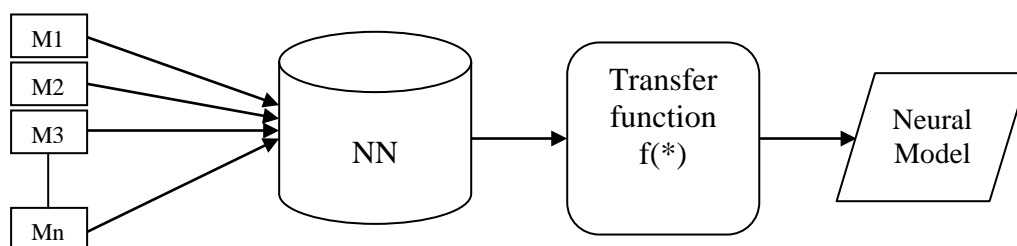
The neural network is one of the self-adaptive data driven methods that is able to adjust themselves to the data without any external indication of the distributional form of functions used this underlying model. They are considered as the universal functional approximates which is able to approximate any of the arbitrary accuracy functions. It is so flexible, when used for modeling the real world complex relationships due to its better non-linear mapping ability. The NN is able to calculate the posterior probability as it provides the basic classification rule for performing the statistical analysis. The network can work parallel to the input variables and also can handle the large sets if data quickly. The main principle of the NN is that it has the ability to extract the irregularities and the patterns for the detection of non-linear connections with multi-dimensional data.

### 1.1 FUNDAMENTALS OF ANN

In general, a network may have hundreds of several synapses, in which the

neurons are able to be connected with hundreds of many other neurons in order to pass the message of signal. Likewise as there are many dendrites are available in each neuron, even a single neuron can receive messages from many other neurons. Also all the interconnections are

weighted equally as such some neurons has higher priority than the others. A schematic model for the neuron model is shown in Figure 1.1.



**Figure 1.1 Neural network models**

## 2. Supervised Learning Techniques

The neural network study is majorly divided into two types such as supervised and unsupervised techniques. In supervised neural network the target outputs are given onto which, the network should map its inputs so that it provides paired data inputs and outputs. It is used to optimize the error arising from the discrepancy between the target and the network output of the network parameters. That is once the network is trained by the inputs, then it is used to produce the outputs for the unseen data. In supervised learning, the neurons are arranged in a layered fashion and is said to be perceptrons. Based on the supervised learning fashion, the perceptrons are trained as such the net can be used to perform a specific function by using the target test set outputs. The supervised learning of NN is; single layer perceptron, multilayer perceptron, Feed Forward Neural Network (FFNN), and Back Propagation (BP).

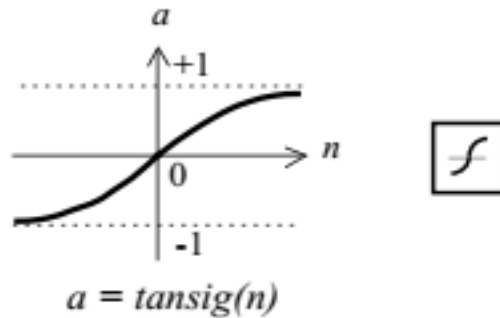
The perceptron learning was first introduced by Rosenblatt in 1958. The perceptron theorem is used to learn and solve anything for which it represents. The single layer perceptron is generally used to classify and learn the object based on their positions in the hyperspace  $n$ -dimensions and is defined as the  $n$ -inputs. It is a mathematical model structure, which is used to classify the points in the hyperspace but not according to the rules that shows the points which are belonged to a particular sets. As the single layer perceptrons are unable to deal the problems occurred in the linearly inseparable data as it ceases the neural nets in it, the multilayered perceptrons which is also known as the Artificial Neural Networks (ANN) method was discovered in the year

1986. This multilayered perceptrons was designed in a way that it is capable of separating the network of training data that are considered as linearly inseparable in nature. This perceptrons consists of large number of neuron units that are joined together to form a pattern of connections. The neural units in this perceptrons are usually segmented into three classes as such; Unit of inputs that processed the information received; Unit of outputs in which the results of the processing are found; the central unit between the inputs and the outputs known as the hidden units. The multilayered perceptrons are of different types as discussed below.

One of the kinds of multilayer neural network known as FFNN which is a function that usually allows the signal to get traveled in only one way that is from input to the output. At first, in order to determine the input and the output mapping function, the network is trained using a set of paired data. The weighted connections between the neurons are fixed and then the network is used to identify the classification of the new data set. When classifying the signal, the input units are propagated all the way to determine the net activation value of all the output units. All the input units will be having an activation value that represents the features eternally to the net that sends the hidden units each of the activation value to each of which it is connected. Then the hidden units will calculate each of its own activation values that are passed on to the output units, and then a simple activation function is used to calculate each of the activation values received. The function is used to sum the contributions of the sending

units, and is defined as the weight of the connections multiplied by the activation value of the sending unit that lies between the sending and the receiving units. The algorithm used to train the artificial neural network method is known as the back propagation neural network algorithm. The training is done usually based on the error signal that has an iterative updating of

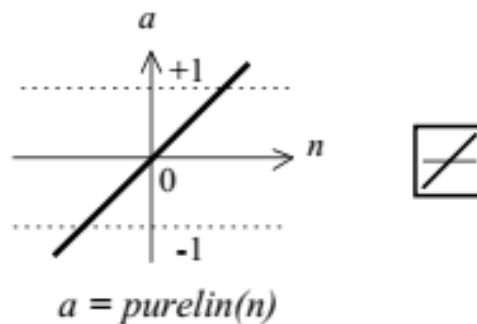
the weights that uses the mean-squared error function of the negative gradients. The error signal is considered as the difference between the actual and the desired output values that are multiplied in the output layer by means of the sigmoidal activation function. Figure 2.1 shows the tan-sigmoid activation function used in NN.



**Figure 2.1 Transfer function (tan-sigmoid)**

The back propagation is a descent algorithm, that are used minimize the error at each iteration when the error signal is back propagated to the lower layer. The weights in this network are adjusted in way that reduction in error rate usually occurs in a decent direction. Usually the method makes use of two

parameters such as; momentum factor and the learning rate so as to control the weight adjustment for the dampening oscillations along with the descent directions. The function used in the output layer is the linear function. Figure 2.2 shows the linear function used in NN.



**Figure 2.2 Linear functions in the output layer**

Based on the system framework in Figure 2.2, the steps like pre-processing signal transformation and feature extraction are performed before classification. The identification of speaker is done by using NN classifier. At first, the NN classifier is trained by using the extracted features of training speech signals and then the trained NN is used to identify the speaker.

### 3. CONCLUSION

To analyze the performance 400 signals are generated and modulated using three modulation schemes; BPSK, QPSK, QAM. They are transmitted through AWGN channel

with 0dB, 1dB, 5 dB, and 10dB noise density. Using temporal and spectral features with ANN classifier with 5, 10, 15, 20 and 25 hidden layers are taken for the modulation of the signals are classified. 300 signals are used for training and 100 signals are tested with ANN classifier with different distance measures; Euclidean, city block, cosine and correlation.

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