|| Volume 5 || Issue 11 || November 2020 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

SONAR DATA CLASSIFICATION USING MULTI-LAYER PERCEPTRON

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Abstract:- With massive improvements in software technologies and artificial intelligence, nowadays data science is being used in multiple domains for various purposes. Deep learning, machine learning, Artificial intelligence have gained prominence in recent times and are successfully being used in domains like Speech Processing, Image Processing, Audio and Video processing, Text processing, natural language processing, etc. The advantage of deep learning is that it has better learning abilities compared to other machine learning algorithms like supervised learning and semi-supervised learning. This feature of deep learning enables it to be used for different datasets for patterns and behavior extractions. The core pillar for developing a very good neural network is Perceptron. It is more of a computational model and evaluates unsupervised data and thus it becomes a trusted tool for developing models for data analytics. The main objective of this project is to solve real-time problems like solar data classification using deep learning. In this project, we elaborate on how to construct deep neural networks using perceptron and tensor flow. This methodology can be used to solve many other real-time problems in multiple domains. In this project, we also work with non-discrete datasets. We observe that our model is still well behaved and produced the desired results.

Keywords:- *Deep Learning, TensorFlow , Machine Learning,, Perceptron Learning algorithm,*

I INTRODUCTION

The submarines used by naval forces protect the coast from unauthorized entry into the country. The submarines send and receive sonar signals to understand what kind of objects are present in the sea. Sometimes there might be mines that can pose a threat to the coast and they have to be identified. Hence it is important to analyze these sonar signals that bounced back to understand whether the object present within the range of the submarine is a rock or a mine [1][5]. This is a real-world scenario that must be solved by machine learning techniques. Machine learning techniques are mostly used for data prediction and analytics. In order to make the model learn it has to be trained with a lot of sample data. The more the sample data, the more the model is trained and the better would be the accuracy when it is used to test unknown data [3][7]. Traditional machine learning techniques cannot be used for this scenario as there would be multiple inputs in the case of sonar data classification. Multiple parameters such as energy levels of the sonar signals, angles at which the sonar signal is sent, angles at which the signals are received, the strength of the signal, distance traveled by the signal a many more parameters would be required to analyze whether the object is a rock or a mine [2][4]. Hence in this scenario, deep learning is a suitable mechanism to evaluate the sonar data and create a model to train and test the data. The general steps followed to apply a deep learning algorithm to any scenario are mentioned below:

1. Understand and identify the inputs that are required for production. This is called feature extraction.
2. Identify the suitable deep learning algorithm for this scenario
3. training the model with sample data and evaluating its performance with test data
4. Use the trained model to guess or predict the known data.

The different types of deep learning mechanisms are:

1. Supervised learning
2. Unsupervised learning
3. Semi-supervised learning

Supervised learning:

Supervised learning is a mechanism where the model learns based on the mapping between input and

output pairs. The sample data is collected search that the input and output are fixed [6]. The model will try to map the features of the unknown data but the sample data that it has got trained. If the features do not match, then the model cannot predict the output accurately [9].

Unsupervised learning:

A neural network that can learn itself and organize itself and can identify the underlying patterns in the unlabeled data is an unsupervised learning mechanism. Perceptron is one such example of unsupervised learning [8].

Semi-supervised Learning:

The learning methodology of semi-supervised learning is a combination of both supervised and unsupervised learning. A small amount of label data is combined with large amounts of unlabeled data to train the model[10].

II LITERATURE SURVEY

1. **Machine learning and deep learning methods for cybersecurity**

With the rapid advancements in the Internet, how cyber-attacks are conducted are changing rapidly and cybersecurity is in a compromising situation. This paper analyzes various machine learning techniques and proposes different ways for the detection of network intrusions. The network security system consists of multiple systems which include firewalls, antivirus software, and other network intrusion detection systems. The intrusion detection system's Main purpose is to recognize unauthorized system behavior like copying and modification.

2. **Extreme learning machine for multilayer perceptron**

The extreme learning machine is a novel algorithm that is gaining prominence due to its extreme learning abilities. This is used by multilayer perceptron neural networks. But in some scenarios, ELM might not be effective enough. Hence a novel architecture is proposed which has self-taught feature extraction with supervised feature classification and randomly initialized concealed weights. Due to the hierarchically encoded outputs, the performance is better than the layer-wise training given by many deep learning mechanisms. It can be applied in multiple domains as it is tested with a higher learning efficiency and has the capability to be extended to multiple domains.

3. **Multi-view perceptron: a deep model for learning face identity and view representations.**

Multiple factors such as light, view, and identity are involved in face recognition systems. It is a big challenge To separate all these three above features for face recognition the traditional face recognition systems use certain features to improve face recognition accurately. However, it is identified that our brain also has a network to process and identify a face. Inspired by the above technique, this paper proposed a novel algorithm for face recognition called multi-view perceptron. The ability of this algorithm is that it can separate all the features distinctively and use them as the inputs to produce a model for face recognition. This algorithm has been tested to identify various 2D faces and the results are satisfactory.

III SYSTEM ANALYSIS

Existing system:

Sonar signals are sent from the ship to identify any objects that at present near it. The signals are sent out and they bounce back from a metal mine or a rock. They come back under several circumstances end at different angles. The signals that are bounced back are recorded end and energy level is associated with each of them. Sixty dissimilar energy levels are captured by the solar output. These energy levels vary from 0 to 1. The energy level is the indicator that is used to predict whether the bouncer back sonar signal is a rock or a mine. Traditional machine learning techniques cannot be used to solve the problem mentioned in the above use case due to the below reasons:

1. the number of inputs is numerous
2. Though, the problem is a linear classification problem, it has nonlinear data.
3. Logistic regression cannot be used to solve this problem.
4. It is difficult to train the model using traditional machine learning techniques.

Proposed system:

When traditional machine learning techniques fail, deep learning presents a solution to this problem. Deep learning using perceptron is advised to use in this scenario because the learning methodology of the model is similar to the functioning of the brain cells. Hence, we build up an artificial neural network with multiple layers of perceptron which are used to learn and train the model.

The results produced by using this algorithm for classifying the sonar data are satisfactory.

Features of perceptron algorithm:

1. Used to solve real-world problems that have a high number of inputs.
2. Can be used to create models for complicated training methodologies.

IV IMPLEMENTATION

Below are the implementation steps for training a model using a multilayer perceptron algorithm:

Inputs:

1. The first step in building a model using the perceptron algorithm is to identify the inputs to the model and feedit to the first layer as input. The perceptron model can handle any number of inputs which are denoted by x1, x2, x3…xn

Weights:

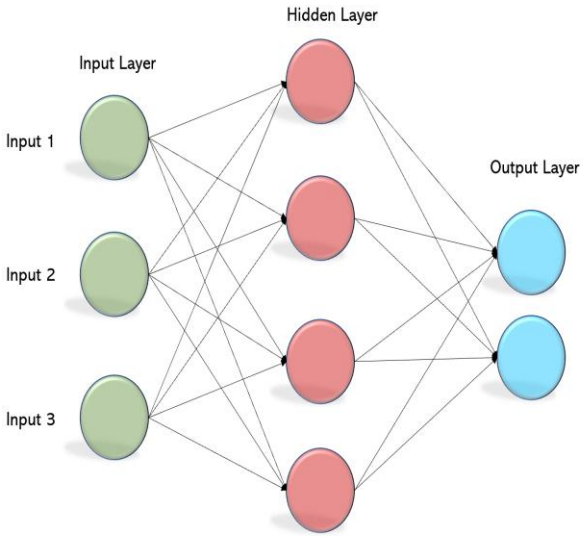
2. Training of the model is done with the help of weights. They are initialized at the beginning of the program and are denoted by w1, w2, w3… wn. They are multiplied with the inputs and once added to the inputs.

Bias:

3. Bias value is an important part of training the model and it is calculated by adding it to the weighted sum and this shifts the output function. It is a unique type of input that permits the classifier to transfer itself from its initial position do either left alright after power down. This feature of bias facilitates better quality and quicker model training. Perceptron Algorithms are of two types: Single layer and multilayer. the neurons are arranged into a single layer in a single layer perceptron whereas in a multilayer perceptron the neurons are organized into multiple layers. in a multilayer perceptron, the first layer takes the inputs, processes them, and gives the output to the second layer. The output of the first layer becomes the input to the second layer. This process is repeated until the processing reaches the last layer.

Activation:

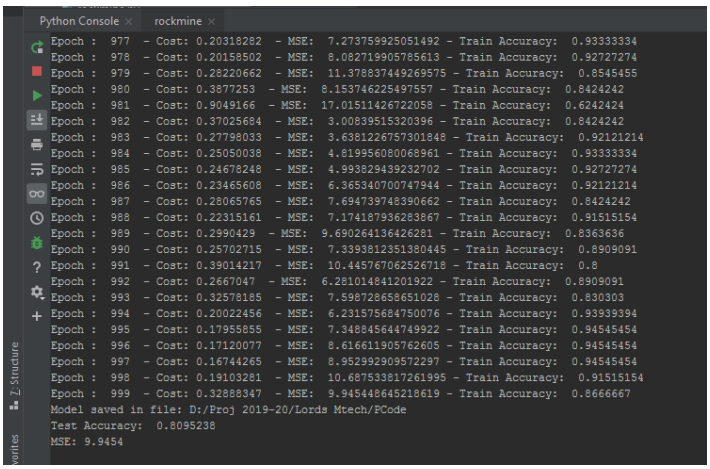
4. The output of the last layer is given to the activation function. These functions are primarily used in the construction of nonlinear networks. The main objective of these functions used to convert the value of the neural network to a zero or one. The activation function that must be used changes from scenario to scenario. This converts the nonlinear model into a linear model and makes it easy for the classifier to classify the data. The output of the activation function is considered as the output value.



V PROJECT EXECUTION AND TESTING

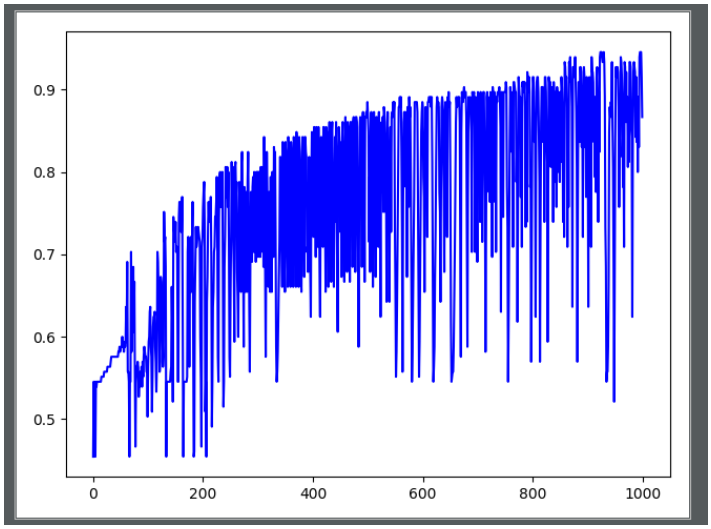
Output:

Below is the output screen for the classification of sonar data. We have configured the model to run for 1000 epochs. Each epoch is an iteration of the whole input data to train the model. The cost, mean square error, and training accuracy are computed and displayed for each epoch. The model is saved to the repository and the final output of test accuracy and mean squared error are displayed.



Graph:

Below is the graph that gets generated using matplot library after the training completes.



VI CONCLUSION

In this project, we have successfully built a model to classify the SONAR data. We can predict whether the object might be a rock or a mine with an accuracy of about 85% with the epoch count being 999. In our project we are using a multilayer perceptron and the perceptron is being used as a linear classifier. Even though we have used non-separable datasets for training the model, the model has given appropriate results. Hence, we conclude that perceptron is it trustable algorithm used for building deep neural networks and training data sets in multiple real-time scenarios.

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