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ANN for Predicting Animals Category

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***Abstract*:** *In this paper an Artificial Neural Network (ANN) model, was developed and tested for predicting the category of an animal. There is a number of factors that influence the classification of animals. Such as the existence of hair/ feather, if the animal gives birth or spawns, it is airborne, aquatic, predator, toothed, backboned, venomous, has –fins, has-tail, cat-sized, and domestic. They were then used as input variables for the ANN model. A model based on the Multilayer Perceptron Topology was developed and trained, using data set, which its title is "Zoo Data Set" and was obtained from Machine Learning Repository, and its created by Richard Forsyth. Test data evaluation shows that the ANN model is able to correctly predict the animal category with 100% accuracy.*

Keywords: Artificial Neural Networks, animal classification, ANN, Predictive Model.

1. INTRODUCTION

The main objective of the animal classification prediction system is to determine the animal category based on attributes which are set of observations for the animal characteristics.
The study seeks to explore the possibility of using an Artificial Neural Network model to predict the category of an animal.
A practical approach is to apply common regression analysis in which historical data are best fitted to some function. The result is an equation in which each of the inputs xj is multiplied by a weight wj; the sum of all such products and a constant θ, then gives an estimate of the output $y = \Sigma\ wj\ xj + \theta$, where j=0..n.
The problem here is the difficulty of choosing an appropriate function that proficient for capturing all formulas of data associations as well as automatically adjusts output in case of further information, since prediction is controlled by a number of factors, and this control will not be clear and known regression model.
ANN emulates the human brain in solving a problem, which is more common way that can handle those kinds of problems. Therefore, the attempt to build an adaptive system such as Artificial Neural Network to predict an animal category based on the consequence of these factors.

The purposes of this study are:

- To recognize some proper factors that affects animals classification, and
- To model an Artificial Neural Network that can be used to predict the animal category based on some predetermined characteristics for a given animal.

2. LITERATURE REVIEW

There are many studies involving Artificial Neural Network (ANN) for example : Artificial Neural Networks and expert systems were employed to obtain knowledge for the learner model in the Linear Programming Intelligent Tutoring System (LP-ITS) to be able to determine the academic performance level of the learners in order to offer him/her the proper difficulty level of linear programming problems to solve[8-12,15,18,21-23]; for predicting the performance of a sophomore student enrolled in engineering majors in the Faculty of Engineering and Information Technology in Al-Azhar University of Gaza was developed and tested [37,45]; ANN model was developed and tested to predict temperature in the surrounding environment [20]; for predicting critical cloud computing security issues by using Artificial Neural Network (ANNs) algorithms. However, they proposed the Levenberg–Marquardt based Back Propagation (LMBP) Algorithms to predict the performance for cloud security level [32]; for predicating the MPG rate for the forthcoming automobiles in the foremost relatively accurate evaluation for the approximated number which foresight the actual number to help through later design and manufacturing of later automobile [17,36]; to predict efficiency of antibiotics in treating various bacteria types [40]; to predict the rate of treatment expenditure on an individual or family in a country [46], for detecting early-stage non-small cell lung cancer (NSCLC) [38]; for the diagnosis of hepatitis virus [34,41]; for predicting the Letters from twenty dissimilar fonts for each letter [35], for Email Classification Using Artificial Neural Network [14]; Classification Prediction of SBRCTs Cancers Using Artificial Neural Network [16, 25]; for Diabetes Prediction Using Artificial Neural Network [29]; to predict Birth Weight [19]; to help cars dealers recognize the many characteristics of cars,

including manufacturers, their location and classification of cars according to several categories including: Buying, Maint, Doors, Persons, Lug_boot, Safety, and Overall [13]; for Parkinson's Disease Prediction Using Artificial Neural Network[39,42,44]; for desktop PC Troubleshooting[27]; for Tomato Leaves Diseases Detection Using Deep Learning[26]; Plant Seedlings Classification Using Deep Learning [24,43]; for predicating software analysis and risk management [30,31].

3. THE ARTIFICIAL NEURAL NETWORKS

An Artificial Neural Network (ANN) is a mathematical model that is driven by the functional feature of biological neural networks. A neural network contains an interconnected set of artificial neurons, and it processes information using a connectionist form to computation. As a rule, an ANN is an adaptive system that adjusts its structure based on external or internal data that runs over the network during the learning process.

Current neural networks are non-linear numerical data modeling tools. They are usually used to model tricky relationships among inputs and outputs or to uncover patterns in data. ANN has been applied in several applications with significant accomplishment [1-2]. For example, ANN have been effectively applied in the area of prediction, and handwritten character recognition [3-4].

Neurons are often come together into layers. Layers are groups of neurons that perform similar functions. There are three kinds of layers. The input layer is the layer of neurons that take input from the user program. The layer of neurons that send data to the user program is the output layer. Between the input layer and output layer there are hidden layers. Hidden layer neurons are connected only to other neurons and never directly interact with the user program. The input and output layers are not just there as interface points. Every neuron in a neural network has the opportunity to affect processing. Processing can occur at any layer in the neural network. Not every neural network has this many layers. The hidden layer is optional. The input and output layers are required, but it is possible to have a layer that act as both an input and output layer [4].

ANN learning can be either supervised or unsupervised. Supervised training is accomplished by giving the neural network a set of sample data along with the expected outputs from each of these samples. Supervised training is the most common form of neural network training. As supervised training proceeds, the neural network is taken through several iterations, or epochs, until the actual output of the neural network matches the expected output, with a reasonably small error. Each epoch is one pass through the training samples. Unsupervised training is similar to supervised training except that no expected outputs are provided. Unsupervised training usually occurs when the neural network is to classify the inputs into several groups. The training progresses through many epochs, just as in supervised training. As training progresses, the classification groups are "discovered" by the neural network [3].

Training is the process by which these connection weights are assigned. Most training algorithms begin by assigning random numbers to the weight matrix. Then the validity of the neural network is tested. Next, the weights are adjusted based on validation results. This process is repeated until the validation error is within an acceptable limit [2].

Validation of the system is done once a neural network has been trained and it must be evaluated to see if it is ready for actual use. This final step is important so that it can be determined if additional training is required. To properly validate a neural network validation data must be set aside that is completely separate from the training data [4].

About 80% of the total sample data was used for network training in this paper. and the remaining 20% used for validation.

4. METHODOLOGY

A data set refer to Richard Forsyth [5] was used, it contains a number of factors that are considered to have an effect on the classification of an animal. These factors were classified as input variables. The output variable represents the predicted animal classification based on those inputs.

4.1 The Input Variables

Hair: Boolean
Feathers: Boolean
Eggs: Boolean
Milk: Boolean
Airborne: Boolean
Aquatic: Boolean
Predator: Boolean

Toothed: Boolean
Backbone: Boolean
Breathes: Boolean
Venomous: Boolean
Fins: Boolean
Legs: Numeric (set of values: {0, 2, 4, 5, 6, 8})
Tail: Boolean
Domestic: Boolean
Catsize: Boolean

4.2 The Output Variable

The output variable is the animal Class, and its domain is:
Mammal (1), Bird (2), Reptile (3), Fish (4), Amphibian (5), Bug (6), Invertebrate (7).

5. The Neural Network

5.1 Network Architecture

The network is a multilayer perceptron neural network using the linear sigmoid activation function as seen in Figure 1.

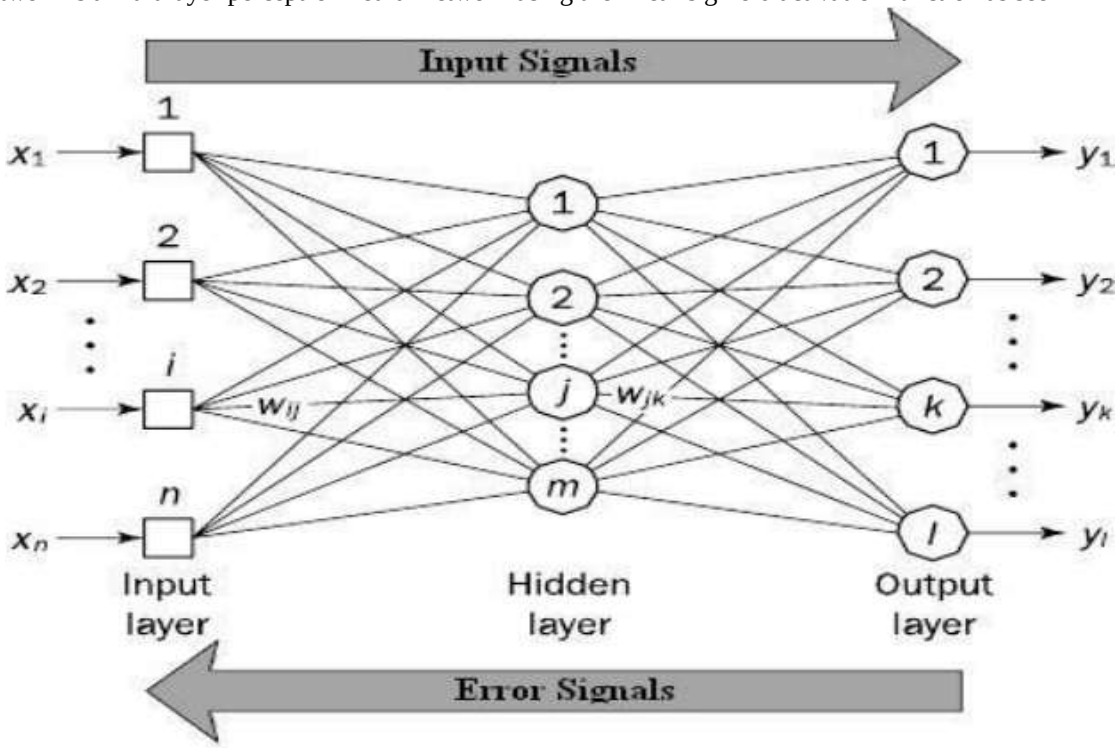

Figure 1: Artificial Neural System Architecture

5.2 The Back-propagation Training Algorithm

- Initialize each wi to some small random value
- Until the termination condition is met, Do
- For each training example <(x1,…xn),t> Do
- Input the instance (x1,…,xn) to the network and compute the network outputs o_k
- For each output unit k: δk=ok(1-ok)(tk-ok)
- For each hidden unit h: δh=oh(1-oh) Σk wh,k δk
- For each network weight wj Do wi,j=wi,j+Δwi,j,where Δwi,j= η δj xi,j and ηis the learning rate.

5.3 Design of the neural network

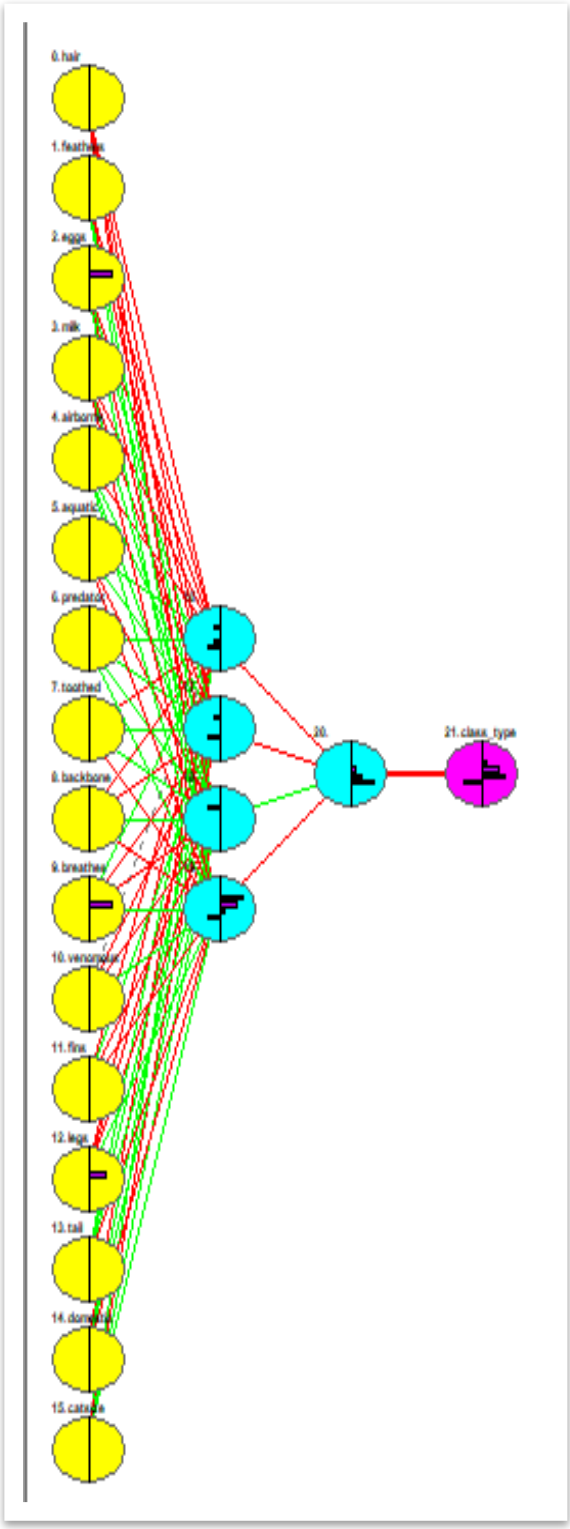

Figure 2: Animal Classification ANN

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6. Reports and Charts

The learning algorithm was able to determine the input variables importance as shown in figure (3).

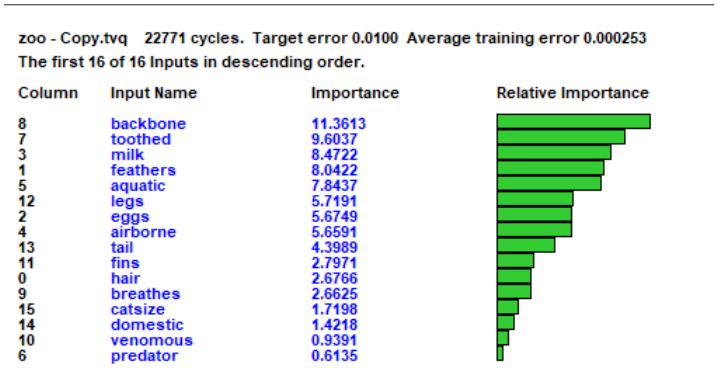

Figure 3: Input variables importance

Moreover, figure (4) shows the errors rates information after learning and validation are done.

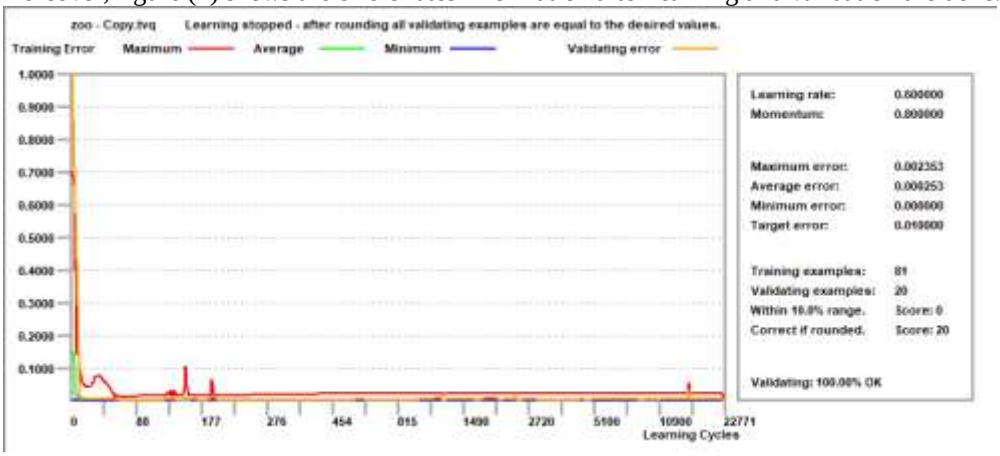

Figure 4: Error rates vs. learning cycles

7. Evaluation of The Neural Network

As mentioned previously, the purpose of this experiment was to predict the animal classification. Where we used animal characteristic, which provides the possibility to implement and test the neural network and its learning algorithm. Our neural network is designed to classify the animal based on some attributes.

After training and validation, the network was tested using a test records and the following results were obtained. This involves inputting variable input data into the grid without output variable results. The output from the grid is then compared with the actual variable data.

The neural network was successfully able to accurately classify 100% of the data.

8. Conclusion

An artificial Neural Network model for predicating animal category was offered. The model used feed forward backpropagation algorithm for training. The factors for the model were obtained from data set represents animal characteristics of each animal category. The model was tested and the total result was 100%. This study showed the probable of the artificial neural network to predicating animal category.

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