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Artificial Neural Network for Predicting Car Performance Using JNN

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***Abstract**: In this paper an Artificial Neural Network (ANN) model was used 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. ANN was used in forecasting car acceptability. The results showed that ANN model was able to predict the car acceptability with 99.12 %. The factor of Safety has the most influence on car acceptability evaluation. Comparative study method is suitable for the evaluation of car acceptability forecasting, can also be extended to all other areas.*

Keywords: Artificial neural networks, JNN, Car, performance.

1. INTRODUCTION

This study evaluates the utilization of neural networks for predicting suitability of a car. It justifies the use of neural networks in this industry for the prediction process. Generally, car manufacturing industries include design, development, manufacturing, marketing and sale of different equipment for motor vehicles. The set of companies and factories involved in design, manufacturing, marketing, and sale of motor vehicles are a part of this industry. In 2009, more than 80 million motor vehicles including regular cars and commercial cars were manufactured around the world. In 2008, a total number of 81.9 million cars were sold in the world, with 24.9 million sold in Europe, 23.4 million sold in Asia and Pacific Region, 21.4 million sold in the US and Canada, 5.4 million sold in Latin America, 3.4 million sold in the Middle East, and 2.4 million sold in Africa[1]. When the market was suffering a recession in the US and Japan, Asia and South America expressively grew and got sturdier. Furthermore, it appears that big markets in Russia, Brazil, India and China have practiced a rapid growth. The car industry, as one of the biggest industries in the world holding a great amount of persons, financial and time resources, is in grim need of precise predictions of its future and its contestants in order to reach great and sensitive decisions [2]. Maybe one of the major concerns of the managers and manufacturers in the car industry and the investors in this field is the prediction of cars sales and arrangement for the future manufacturing volume. If a manager can have a more precise prediction regarding the future sales volume and car demand, they can unconditionally enhance the investment volume, employee workforce and optimally use time to reach optimal decisions and convey out instruction plans [3,4].

2. ARTIFICIAL NEURAL NETWORKS

Artificial intelligence has started from the very beginning, how can we simulate that mind, how can devices have the ability to discriminate, how can we make that device that distinguishes between water and fire? These devices, despite their high speed and ability to deal with millions of data in parts of the second could not do a lot of things done by the human, for example I bring a small child in the tenth, and offer him a set of images, all this simple child will know the image of the cat, tree and other images. This process is simple may be very complex too for the device and even Super-Computer too! From here scientists began to question and research, how this person can do these things, and here the mind is the answer, i.e. trying to imitate the mind and simulating it. But this word of mind despite its simplicity that the human mind is very complex, so scientists had to search more and try to find the things that make up the mind, and from here was the beginning to study the nerve cell, which is the simplest model exists in mind, and the collection of these cells to make a network of cells, and from here we began studying neural networks (note that we are now talking about neural networks within the brain. Artificial neural networks (ANNs) are parallel computational models comprised of densely interconnected, adaptive processing units, characterized by an inherent propensity for learning from experience and also discovering new knowledge. Due to their excellent capability of selflearning and self-adapting, they have been extensively studied and have been successfully utilized to tackle difficult real-world problems and are often found to be more efficient and more accurate than other classification techniques. Classification with a neural network takes place in two distinct phases. First, the network is trained on a set of paired data to determine the input-output mapping. The weights of the connections between neurons are then fixed and the network is used to determine the classifications of a new set of data. Although many different models of ANNs have been proposed, the Feedforward Neural Networks (FNNs) are the most common and widely used in a variety of applications [5,6].

3. LITERATURE REVIEW

Artificial Neural Networks have been used many fields. In Education such as: Predicting Student Performance in the Faculty of Engineering and Information Technology using ANN, Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza using ANN, Arabic Text Summarization Using AraBERT Model Using Extractive Text Summarization Approach[6,7].

In the field of Health such as: Parkinson's Disease Prediction, Classification Prediction of SBRCTs Cancers Using ANN], Predicting Medical Expenses Using ANN, Predicting Antibiotic Susceptibility Using Artificial Neural Network, Predicting Liver Patients using Artificial Neural Network, Blood Donation Prediction using Artificial Neural Network, Predicting DNA Lung Cancer using Artificial Neural Network, Diagnosis of Hepatitis Virus Using Artificial Neural Network, COVID-19 Detection using Artificial Intelligence[8,9].

In the field of Agriculture: Plant Seedlings Classification Using Deep Learning, Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network, Analyzing Types of Cherry Using Deep Learning, Banana Classification Using Deep Learning, Mango Classification Using Deep Learning, Type of Grapefruit Classification Using Deep Learning, Grape Type Classification Using Deep Learning, Classifying Nuts Types Using Convolutional Neural Network, Potato Classification Using Deep Learning, Age and Gender Prediction and Validation Through Single User Images Using CNN[10,11].

In other fields such as : Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods, Predicting Overall Car Performance Using Artificial Neural Network, Glass Classification Using Artificial Neural Network, Tic-Tac-Toe Learning Using Artificial Neural Networks, Energy Efficiency Predicting using Artificial Neural Network, Predicting Titanic Survivors using Artificial Neural Network, Classification of Software Risks with Discriminant Analysis Techniques in Software planning Development Process, Handwritten Signature Verification using Deep Learning, Email Classification Using Artificial Neural Network, Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network, English Alphabet Prediction Using Artificial Neural Networks[12,13].

4. METHODOLOGY

By looking deeply through the cars types and soliciting the experience of human experts on cars performance, a number of factors that are considered to have an effect on customer response were outlined. These factors were cautiously studied and synchronized into a convenient number appropriate for computer coding within the Just Neural Network (JNN) environment. These factors were classified as input variables as shown in table 1. The output variables embody some likely levels of performance of cars in terms of Excel file with a study summary performance of cars as shown in table 2.

4.1 The input Variable:

The attribute which represent the input variable are shown in Table 1.

Table 1: Input Data Transformation

Attributes:	**Usage:**	**Type:**	**Values:**
Buying	Input	Categorical	v-high, high, med, low
Maint	Input	Categorical	v-high, high, med, low
Doors	Input	Categorical	2, 3, 4, 5-more
Persons	Input	Categorical	2, 4, more
Lug_boot	Input	Categorical	small, med, big
Safety	Input	Categorical	low, med, high

4.2 The output Variable:

The attribute which represent the output variable is called overall which can be Un-acceptable, acceptable, good, or very good.

Table2: shows the output variable

Attributes	Usage	Type	Values
Overall	Output	Categorical	unacc, acc, good, vgood

4.3 Dataset of Car performance

We collected the dataset concerning the Car performance from UCI Machine Learning Repository [14]. There are 1728 instances in the car dataset with 7 attributes.

4.4 Building the ANN Model

We have used Just Neural Network (JNN) tool [15] to build a multilayer ANN model. The proposed model consists of 3 Layers: Input Layer with 6 nodes, one Hidden Layer with 4 nodes, and Output Layer with one node as can be seen in Figure 1.

We have sat the parameters of the proposed model as follows: Learning Rate 0.37 and the Momentum to be 0.46, and Average Error rate to be 0.01 (as shown in Figure 2).

4.5 Evaluating the ANN model

The car performance dataset consists of 1728 samples with 7 attributes as Table 1 and Table 2. We imported the CSV file of the car performance dataset into the JNN environment (as seen in Figure 3). We divided the imported dataset into two groups (Training and Validation) randomly using the JNN tool. The Training consists of approximately 67% (1158 samples) and the validation set consists of 33% of the dataset (570 samples). After making sure that the parameter control was sat properly, we started training the ANN model and keeping eye on the learning curve, loss error and validation accuracy. We kept training the ANN model for 59576 cycles. The best accuracy we got was 92.11% (as seen in Figure 4). We determined the most influential factors in the car performance dataset as in Figure 5. Figure 6 shows the summary of the proposed model.

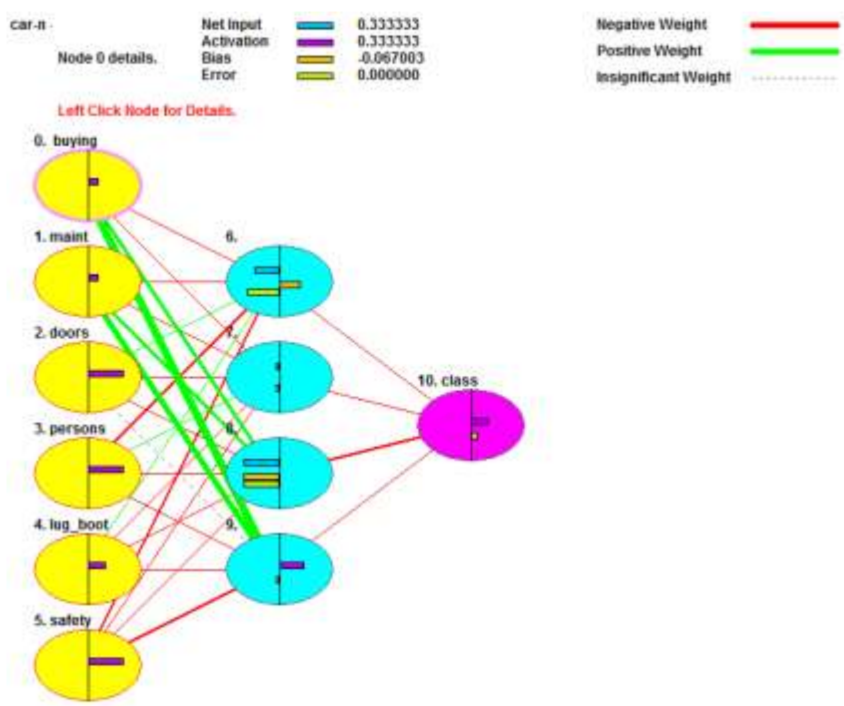

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Figure 1: Final ANN model Architecture

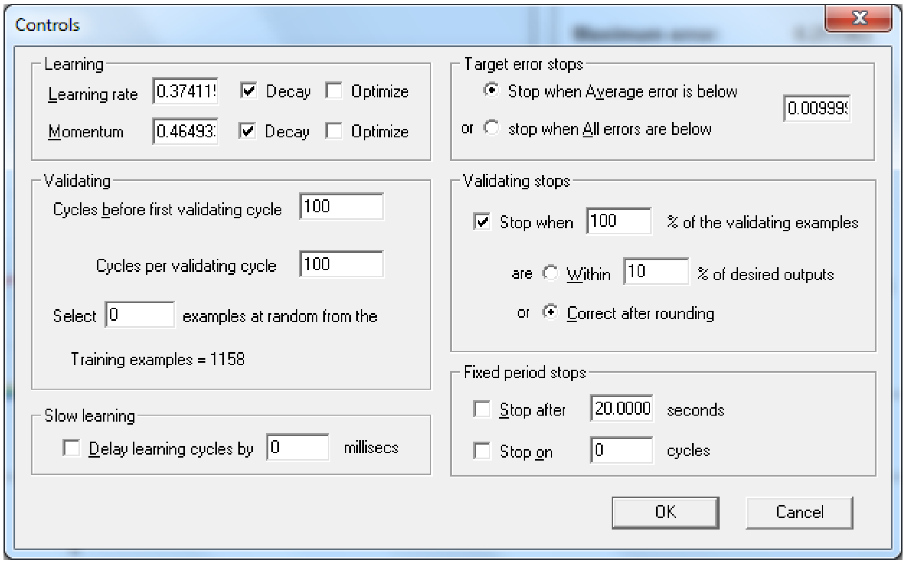

Figure 2: Parameters values of the proposed ANN model

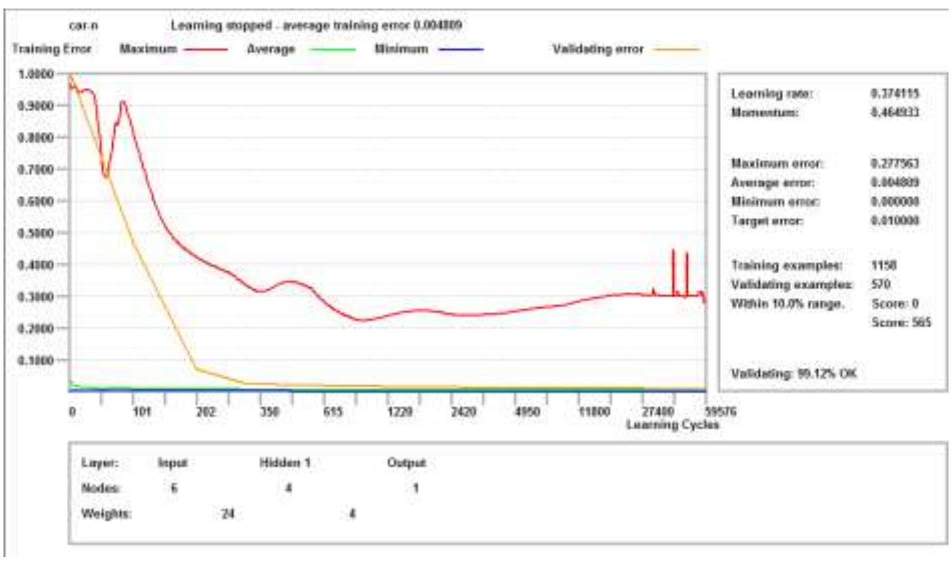

Figure 4: Training and validation Summary

car-n

	buying	maint	doors	persons	lug_boot	safety	class
#0	0.6667	0.6667	0	0.6667	1	1	0.3333
#1	0.3333	0.6667	0	0.6667	1	1	0.3333
#2	0.6667	0.0000	0	0.6667	1	1	0.3333
#3	1.0000	0.0000	0	0.6667	1	1	0.3333
#4	0.6667	0.3333	0	0.6667	1	1	0.3333
#5	1.0000	0.3333	0	0.6667	1	1	0.3333
#6	0.0000	1.0000	0	0.6667	1	1	0.3333
#7	0.3333	1.0000	0	0.6667	1	1	0.3333
#8	0.6667	0.6667	0	0.6667	1	1	0.3333
#9	0.3333	0.6667	0	0.6667	1	1	0.3333
#10	0.6667	0.0000	0	0.6667	1	1	0.3333
#11	1.0000	0.0000	0	0.6667	1	1	0.3333
#12	0.6667	0.3333	0	0.6667	1	1	0.3333
#13	1.0000	0.3333	0	0.6667	1	1	0.3333
#14	0.0000	1.0000	0	0.6667	1	1	0.3333
#15	0.3333	1.0000	0	0.6667	1	1	0.3333
#16	0.6667	0.6667	1	0.6667	1	1	0.3333
#17	0.3333	0.6667	1	0.6667	1	1	0.3333
#18	0.6667	0.0000	1	0.6667	1	1	0.3333
#19	1.0000	0.0000	1	0.6667	1	1	0.3333
#20	0.6667	0.3333	1	0.6667	1	1	0.3333
#21	1.0000	0.3333	1	0.6667	1	1	0.3333
#22	0.0000	1.0000	1	0.6667	1	1	0.3333
#23	0.3333	1.0000	1	0.6667	1	1	0.3333
#24	0.6667	0.6667	1	0.6667	1	1	0.3333
#25	0.3333	0.6667	1	0.6667	1	1	0.3333
#26	0.6667	0.0000	1	0.6667	1	1	0.3333
#27	1.0000	0.0000	1	0.6667	1	1	0.3333

Figure 3: A snap shot of the data in JNN environment

car-n 59576 cycles. Target error 0.0100 Average training error 0.004809
The first 6 of 6 Inputs in descending order.

Column	Input Name	Importance	Relative Importance
0	buying	104.8532	
1	maint	85.2451	
5	safety	65.4458	
3	persons	35.3109	
4	lug_boot	22.3242	
2	doors	5.3701	

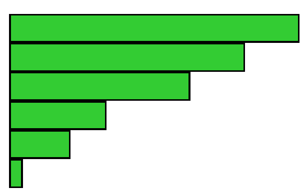

Figure 5: Most influencing factories on ANN model

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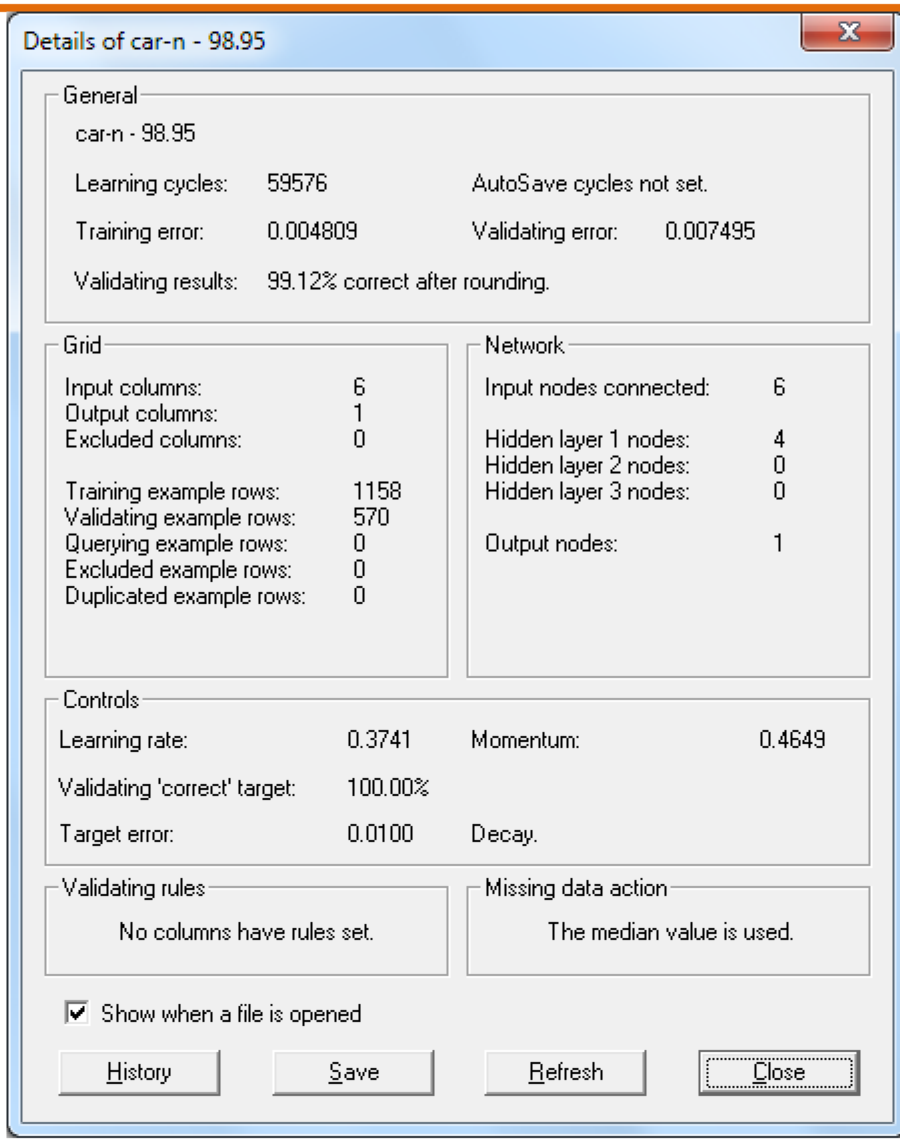

Figure 6 shows the summary of the proposed model

5. CONCLUSIONS

An artificial Neural Network model for predicating overall car performance dataset was collected from UCI Machine Learning Repository was presented. The model used feed forward backpropagation algorithm for training. The factors for the model were obtained from expert in the field. The proposed model was trained and tested. The accuracy rate of the proposed model was 99.12%. This study showed the potential of the artificial neural network for predicating overall car performance.

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