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ANN for Predicting Mobile Phone Price Range

Ibrahim M. Nasser, Mohammed Al-Shawwa

Department of Information Technology
Faculty of Engineering & Information Technology,
Al-Azhar University - Gaza, Palestine
azhar.ibrahimn@gmail.com
mohammed.o.alshawwa@gmail.com

Abstract: *In this paper an Artificial Neural Network (ANN) model, was developed and tested for predicting the price range of a mobile phone.*
We used a dataset that contains mobile phones information, and there was a number of factors that influence the classification of mobile phone price. Factors as battery power, CPU clock speed, has dual sim support or not, Front Camera mega pixels, has 4G or not, has Wi-Fi or not, etc….
20 attributes were 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 "Mobile Price Classification" and was obtained from Kaggle online community, and it is created by Abhishek Sharma.
Test data evaluation shows that the ANN model is able to correctly predict the mobile price renge with 96.31 accuracy.

Keywords: Data Mining, Artificial Neural Networks, mobile price prediction, ANN, Predictive Model.

1. INTRODUCTION

The primary goal of our study is to determine the mobile price range based on attributes which are set of specifications for mobile phones.
The study explores the likelihood of using an Artificial Neural Network model to predict the range of a mobile price.
The purposes of this study are:
To recognize some proper factors that affects mobile price range, and
To model an Artificial Neural Network that can be used to predict the mobile price range based on some predetermined characteristics for a given mobile phone.

Artificial neural networks are one of the main tools used in machine learning. They are brain-inspired systems, which are proposed to imitate the way that humans learn. Neural networks involve input and output layers, as well as (in most cases) hidden layers that transform the input into something so the output layer can use. They are brilliant tools for finding patterns which are too complex for a human to extract, so human could teach the machine to recognize those patterns. [6]. Hidden layer neurons are connected only to other neurons and never directly interact with the user program, 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 has been applied in numerous applications with substantial success [1-2]. For example, ANN have been effectively applied in the area of prediction, and handwritten character recognition. [3-4].

ANN learning can be supervised or unsupervised. Supervised is the most common form of training, it is accomplished by giving the neural network a set of sample data with the expected outputs from each sample. At training, the neural network goes through several iterations, or epochs, until the actual output of the neural network matches the expected output, with small error rate. Unsupervised training is similar to supervised but no expected outputs are given. It usually occurs when the neural network is to classify the inputs into several groups. At training, the classification groups are revealed by the neural network [3].
In Training, connection weights are assigned. Most training algorithms begin by assigning random weights values. Then validation process is done so the neural network is tested and the weights values are edited based on validation results. This process is repeated until the validation error is within an acceptable limit [2].

Model Validation is done once a neural network has been trained to evaluate the model if it is ready for actual use. The results of validation determine if additional training is required. A suggestion to correctly validate a neural network, validation data must be different from the training data [4].

In this paper, we used about 70% of the total sample data for network training, and 30% for network validation.

2. LITERATURE REVIEW

Abu Nasser, et.al. [9-10] build many neural networks for the purpose of class prediction. A paper titled "Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network" was published; their ANN model developed was able to correctly predicting the temperature with 100% accuracy. Another paper titled "Predicting Birth Weight Using Artificial Neural Network" was published; and their ANN model was capable of correctly predicting the birth weight with 100% accuracy.

Muhammad Asim, Zafar Khan [7], published about Mobile Price Class prediction using Machine Learning Techniques to predict If the mobile with given features will be Economical or Expensive, they collect data from the website www.GSMArena.com. Their work concluded comparable results of both Feature selection algorithms and classifier except the combination of WrapperattributEval and Decision Tree J48 classifier. Comparing the results maximum accuracy achieved is 78%, when WrapperattributEval algorithm is used for feature selection and Decision tree as a classifier.

Yonghua Yin, Jiajun Zong, and Quanyin Zhu [8] published a conference paper with the title " Cell Phones Price Forecast Based on Adaptive Sliding Windows". They extracted one-year price for ten types of mobile phone from the website www.360buy.com and used the original data to forecast the price based on the adaptive sliding windows technique. their forecasting average accuracy obtains 99.4%. Their research was useful for consumers, and for businesses in the cell phones market.

3. METHODOLOGY

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

1.1. The Input Variables

1. Battery_power: Total energy a battery can store in one time measured in mAh
2. Blue: Has Bluetooth or not
3. clock_speed: speed at which microprocessor executes instructions
4. dual_sim: Has dual sim support or not
5. fc: Front Camera mega pixels
6. four_g: Has 4G or not
7. int_memory: Internal Memory in Gigabytes
8. m_dep: Mobile Depth in cm
9. mobile_wt: Weight of mobile phone
10. n_cores: Number of cores of processor
11. pc: Primary Camera mega pixels
12. px_height: Pixel Resolution Height Tail
13. px_width: Pixel Resolution Width
14. ram: Random Access Memory in Megabytes
15. sc_h: Screen Height of mobile in cm
16. sc_w: Screen Width of mobile in cm
17. talk_time: longest time that a single battery charge will last when you are talking
18. three_g: Has 3G or not
19. touch_screen: Has touch screen or not
20. wifi: Has Wi-Fi or not

1.2. The Output Variable

The output variable is the price range, and its domain is:

- 0: (low cost),
- 1: (medium cost),
- 2: (high cost), and
- 3: (very high cost).

4. THE NEURAL NETWORK

1.3. Network Architecture

The network is a multilayer perceptron neural network using the linear sigmoid activation function[17-39] as seen in Figure 1.

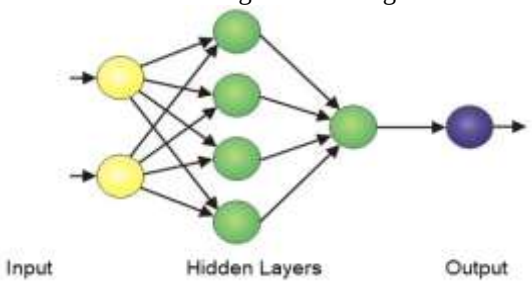

Figure 1: Artificial Neural System Architecture

1.4. The Back-propagation Training Algorithm

Here are the Back-propagation algorithm[40-71]:

- 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.

1.5. Design of the neural network

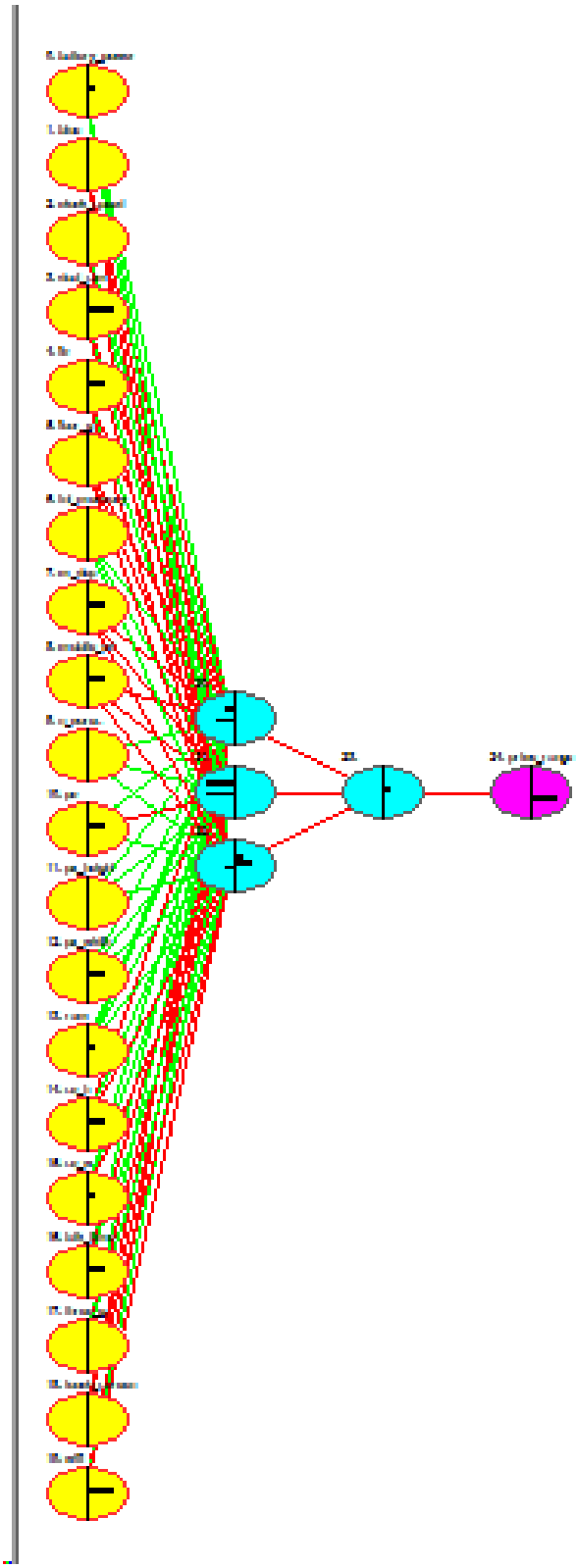

Figure 2: The ANN model

2. Reports and Charts

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

Mobile-Price-Classification-train_2h_v2.tvq 192863 cycles. Target error 0.0100 Average training error 0.000434

The first 20 of 20 Inputs in descending order.

Column	Input Name	Importance
13	ram	756.9812
0	battery_power	187.3531
11	px_height	146.2705
12	px_width	112.3069
8	mobile_wt	35.6818
9	n_cores	13.2685
4	fc	10.8835
10	pc	9.4781
14	sc_h	8.7977
6	int_memory	8.0778
19	wifi	6.0013
17	three_g	5.3201
18	touch_screen	4.7773
1	blue	4.7451
2	clock_speed	4.1937
15	sc_w	4.0761
5	four_g	4.0278
7	m_dep	2.9162
3	dual_sim	2.8698
16	talk_time	0.8351

Relative Importance

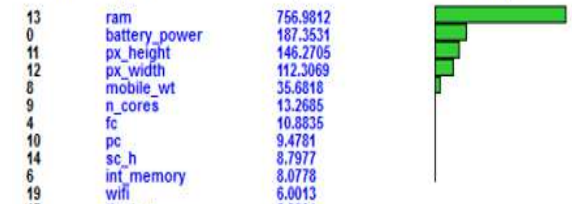

Figure 3: Input variables importance

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

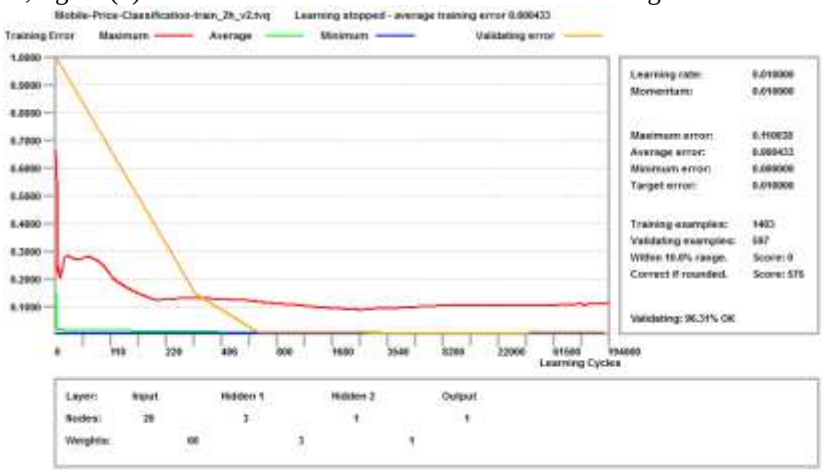

Figure 4: Error rates vs. learning cycles

3. Evaluation of The Neural Network

As mentioned previously, the purpose of this experiment was to predict the mobile price range using phones specifications, which provides the possibility to implement and test the neural network and its learning algorithm.

After training and validation, the network was tested by using a test records without output variable results and the following results were obtained. The output from the model is then compared with the actual one.

The neural network was successfully able to accurately classify 96.31% of the data with average error 0.000434.

5. CONCLUSION

An artificial Neural Network model for predicating mobile phone price range was proposed. The model used feed forward backpropagation algorithm for training. The factors for the model were obtained from data set represents mobile phones specifications. The model was tested and the total result was 96.31% accuracy. This study showed the ability of the artificial neural network to predict mobile phone price range.

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