ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 12, December 2017

'Prediction of Students' Performance: Artificial Neural Network Approach

[1] K. G. Nandha Kumar
Assistant Professor, Department of Computer Science
Dr.N.G.P. Arts and Science College, Coimbatore, India

Abstract: **- Neural network techniques are applied in an ample number of fields in the recent decades. Educational data mining is one among them where the data mining could be carried out effectively. The core tasks are classification, clustering and grasping of association rules. These could be accomplished with suitable educational data. Enormous algorithms, techniques, and tools are available for data mining. Identifying a best suitable algorithm for a specific task is still intricate. This paper deals with the performance of some well formed neural network methods on students' performance prediction. Predictive analysis is a significant task in the education domain. Exploitation of students' mark data leads to the better predictive analysis. In the field of educational data mining, most of the research work focus on predictive analysis and models. There is a scope for multidimensional predictions. This paper indicates some view points of neural network based educational data mining.**

Keywords: **Assessment, Data Mining, Education, Neural Networks, Prediction.**

I. INTRODUCTION

Data mining techniques are being applied successfully in the educational domain. The field of education needs the focus of data miners to carry out efficient researches. It is a platform which provides target for probably all types of data mining tasks. Hence it remains a favorite research area for data analysts in the recent years. Data mining tasks such as classification, clustering, finding association rules, prediction, regression, sequence discovery, summarization, and time series analysis can be carried out with educational data. Generally, data mining techniques are applied in the educational domain for variety of applications [2, 20]. Students' data could be utilized more efficiently through data mining techniques [17]. Predictive analysis plays a vital role in the field of education [5, 19]. The typical applications are; evaluation of students' performance [3, 10], prediction of students' performance such as slow learners, failures, and dropouts [4, 6-11, 13, 16], and performance prediction of instructors [1]. This paper is the outcome of the research made on the students' marks data, to predict the result of end semester exam. The regular multilayer perceptron neural network is applied in this research. Perceptron neural network was discovered in 1962 by Frank Rosenblatt. Minsky, Widrow, Block, and Hoff have modified the same with different capacities.

Educational Data and the Preprocessing Various types of data which represent students' performance are taken for the assessment and prediction. Normally, marks secured by the students in the various assessment methods, tests, exams, assignments, field study, presentation in seminars are used for researches. In this study, marks secured by the students of B.Sc. Computer Science are taken for the research and they are converted as data set. Marks of continuous internal assessment (CIA) tests, marks of assignments, and marks awarded based on classroom performance are considered. The details of data set are represented in the Table 1.

Table 1. Description of the data set.

S. No.	Attributes	Description of the attributes (Marks of various components)	Range of Values	Total number of records
1	Test1	CIA Test I	1 - 50	762 (Marks of Five subjects of 127 students)
2	Test2	CIA Test II	1 - 50	
3	Asmt1	Assignment I	1 - 5	
4	Asmt2	Assignment II	1 - 5	
5	Test3	Model Exam	1 - 75	
6	CRP	Class Room Performance	1 - 5	
7	OE	Online Exam (objective type questions)	1 - 20	

Marks of Class Room Performance are awarded based on three criteria such as Integration of Knowledge, Interaction & Participation, and Demonstration of Knowledge. Marks of assignments are awarded based on three criteria such as Demonstration of Knowledge, Format & Spelling, and References. Every criterion is observed through the five point scale and then the same is added with other criteria and

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 12, December 2017

averaged for five marks. All the values in the data set are normalized according to the requirements of neural networks for the task of prediction of exam result. The normalization is done by using the following equation. Normalized value Xn = Xi - min(X) / max(X) - min(X). Here, Xi is the individual value in the particular attribute, min(X) is the lowest value in the attribute and max(X) is the largest value in the attribute.

Neural Networks as Predictive Models

Artificial neural network (ANN) techniques are soft computing techniques and they resemble the behaviour of human brain in terms of learning the given things. ANN techniques are applied in more number of fields in the recent decades. Education field is one among them where the neural network based data mining could be carried out effectively. The conventional multilayer perceptron neural network (MLP) is applied here for students' performance prediction. It follows supervised learning approach. In this approach, some sample data will be fed to the network for training purpose and the remaining data will be utilized for testing the network. Based on the training data, the weights of the network will be adjusted by itself during the learning process. The algorithm of MLP is specified below.

Procedure: *Multilayer Perceptron Network*
Input: *Students' Marks (Numeric Values)*
Output: *Prediction of End Semester Exam Result (Binary values)*
Steps:

1. *Initialization of the weights and bias.*
2. *Calculation of net input as follows.*

$$y_{in} = b + \sum_{i=1}^{n} x_i w_i$$

3. *Calculation of output through applying the activation function over the net input as follows.*

$$y = f(y_{in}) = \begin{cases} 1 \text{ if } y_{in} > \theta \\ 0 \text{ if } -\theta \le y_{in} \le \theta \\ -1 \text{ if } y_{in} < -\theta \end{cases}$$

4. *Weight and bias adjustments.*
5. *Check for stopping condition.*

A regular multilayer perceptron network has three layers and they are; input layer, hidden layer and output layer. All the three layers are fully interconnected. The input values are fed into the input layer as weights, and then, these will be converted into net input. The hidden layer is the processing unit, in which the activation function is applied. The adjustments will be made automatically by the network. The summarized output will be delivered by the output layer. It will be the final predicted values. This is the working principal of the MLP.

III. EXPERIMENTS AND RESULTS

Generally, MLP neural networks will have a single hidden layer, but at certain situations where the accuracy plays a major role, an extra hidden layer can be added there. In this study, both the types of MLP networks are applied: one with the single hidden layer and another one with the double hidden layer. Fixing the number of neurons in each layer is significant and it influences the results. Hence, the different combinations are tried in terms of number of neuron in the hidden layer. The number of neurons in the input and output layers of all the models remain the same. The number of neurons of input and hidden layers is fixed based on the number of attributes of the data set. Then the number of neurons of hidden layers is doubled and tripled in order to obtain the better accuracy of prediction. All these layers are fully interconnected and feed forwarded. The detailed plan of constructed neural networks is represented in the Table 2.

S. No.	MLP neural network	No. of neurons in the input layer	No. of hidden layers	No. of neurons in the hidden layer	No. of neurons in the output layer
1	MLP 1	7	1	7	2
2	MLP 2	7	2	7	2
3	MLP 3	7	1	14	2
4	MLP 4	7	2	14	2
5	MLP 5	7	1	21	2
6	MLP 6	7	2	21	2

Table 2. Description of the structure of MLP neural networks.

All these neural networks are developed by using Python language and the efficiency of the networks is evaluated by the X-cross validation method. The X value is fixed to 12 in this study. To achieve the better accuracy in the prediction of students' performance in the end semester exam is the ultimate objective here. Hence, different combinations of layers are experimented to improve the accuracy. The performances of all the neural networks are presented in the Table 3.

Table 3. Accuracy of all the MLP neural networks.

Validations	MLP 1	MLP 2	MLP 3	MLP 4	MLP 5	MLP 6
Validation 1	0.820	0.816	0.827	0.911	0.859	0.949
Validation 2	0.794	0.861	0.861	0.883	0.848	0.937
Validation 3	0.829	0.917	0.856	0.941	0.874	0.871
Validation 4	0.843	0.857	0.862	0.898	0.843	0.863
Validation 5	0.830	0.908	0.879	0.927	0.868	0.924
Validation 6	0.784	0.924	0.875	0.916	0.823	0.892
Validation 7	0.836	0.904	0.848	0.847	0.832	0.917
Validation 8	0.840	0.837	0.857	0.881	0.852	0.968
Validation 9	0.857	0.873	0.832	0.893	0.857	0.921
Validation 10	0.859	0.793	0.836	0.833	0.898	0.896
Validation 11	0.744	0.878	0.859	0.884	0.984	0.948
Validation 12	0.838	0.839	0.862	0.916	0.895	0.927

The average value of all the experiments of the every neural network is considered as its achieved prediction accuracy. The average prediction accuracy of MLP1, MLP2, MLP3,

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 12, December 2017

MLP4, MLP5, and MLP6 are 82.3%, 86.7%, 85.5%, 89.4%, 86.9%, and 91.8% respectively. The average prediction accuracy of MLP networks which has single hidden layer is 84.9% and the average prediction accuracy of MLP networks which has double hidden layers is 89.3%. This shows the influence of number of hidden layers in the neural networks.

IV. CONCLUSION AND FURTHER DIRECTION

In this study, the performance of the under graduate students in the end semester exam is predicted by using neural network techniques. This study focuses mainly on the accuracy of prediction; hence, the other evaluation metrics such as learning time of neural network are less bothered. The experimental results show that the multilayer perceptron neural networks which has two hidden layers have produced better results in terms of accuracy, when compared with the MLPs which has only single hidden layer. The increment of number of neurons in the hidden layers leads to better accuracy. Other neural network techniques such as back propagation models, recurrent neural networks could be used to achieve the maximum accuracy. Optimization techniques could be applied on neural network structures if minimization of processing time is required. Different hybrid techniques from soft computing approaches could be experimented.

REFERENCES

1. Agaoglu M.: Predicting Instructor Performance Using Data Mining Techniques in Higher Education. IEEE Access. vol. 4, pp. 2379-2387, (2016).

2. Ali Buldu and Kerem Ucgun.: Data Mining Application on Students' Data. Procedia – Social and Behavioral Sciences. vol. 2, pp. 5251-5259, (2010).

3. Baha Sena and Emine Ucarb.: Evaluating the Achievements of Computer Engineering Department of Distance Education Students with Data Mining Methods. Procedia Technology. vol. 1, pp. 262 – 267, (2012).

4. Chun-Teck Lye, Lik-Neo Ng, Mohd Daud Hassan, Wei-Wei Goh, Check-Yee Law, and Noradzilah Ismail.: Predicting Pre-university Students' Mathematics Achievement. Procedia - Social and Behavioral Sciences. vol. 8, pp. 299–306, (2010).

5. Deepthi Upendran, Shiffon Chatterjee, Sindhumol S, and Kamal Bijlani.: Application of Predictive Analytics in Intelligent Course Recommendation. Procedia – Computer Science. Vol. 93, pp. 917-923, (2016).

6. Elbadrawy A., Polyzou A., Ren Z., Sweeney M., Karypis G. and Rangwala H.: Predicting Student Performance Using Personalized Analytics. Computer, vol. 49, no. 4, pp. 61-69, (2016).

7. Farshid Marbouti, Heidi A Diefes-Dux and Krishna Madhavan.: Models for Early Prediction of at-risk Students in a Course using Standards-Based Grading. Computers & Education, Vol. 103. Pp. 1-15, (2016).

8. Ghada Badr, Afnan Algobail, Hanadi Almutairi and Manal Almutery.: Predicting Students' Performance in University Courses: A Case Study and Tool in KSU Mathematics Department. Procedia – Computer Science. Vol. 82, pp. 80-89, (2016).

9. Heredia D., Amaya Y. and Barrientos E.: Student Dropout Predictive Model Using Data Mining Techniques, IEEE Latin America Transactions, vol. 13, no. 9, pp. 3127-3134, (2015).

10. Lima Vasconcelos F. H., Veloso da Silva T. E. and Moura Mota J. C.: Multilinear Educational Data Analysis for Evaluation of Engineering Education. IEEE Latin America Transactions. vol. 13, no. 8, pp. 2785-2791, (2015).

11. López Guarín C. E., Guzmán E. L. and González F. A.: A Model to Predict Low Academic Performance at a Specific Enrollment Using Data Mining. IEEE Revista Iberoamericana de Tecnologias del Aprendizaje. vol. 10, no. 3, pp.119-125, (2015).

12. Manolis Chalaris, Stefanos Gritzalis, Manolis Maragoudakis, Cleo Sgouropoulou and Anastasios Tsolakidis.: Improving Quality of Educational Processes Providing New Knowledge using Data Mining Techniques. Procedia – Social and Behavioral Sciences. Vol. 147, pp. 390-397, (2014).

13. Marquez-Vera C., Morales C. R. and Soto S. V.: Predicting School Failure and Dropout by Using Data Mining Techniques. IEEE Revista Iberoamericana de Tecnologias del Aprendizaje. vol. 8, no. 1, pp. 7-14, (2013).

14. Merchan Rubiano S. M. and Duarte Garcia J. A.: Analysis of Data Mining Techniques for Constructing a Predictive Model for Academic Performance. IEEE Latin America Transactions. vol. 14, no. 6, pp. 2783-2788, (2016).

15. Mohammed I Al-Twijri and AminY Noaman.: A New Data Mining Model Adopted for Higher Institutions. Procedia – Computer Science. Vol. 65, pp. 836-844, (2015).

16. Mrinal Pandey and S Taruna.: Towards the Integration of Multiple Classifier Pertaining to the Student's Performance Prediction. Perspectives in Science. Vol. 8, pp. 364-366, (2016).

17. Nurbiha A Shukor, Zaidatun Tasir and Henny Van der Meijden.: An Examination of Online Learning Effectiveness using Data Mining. Procedia – Social and Behavioral Sciences. Vol. 172, pp. 555-562, (2015).

18. Parneet Kaura, Manpreet Singhb, and Gurpreet Singh Josanc.: Classification and Prediction Based Data Mining Algorithms to Predict Slow Learners in Education Sector. Procedia - Computer Science. vol. 57, pp. 500 – 508, (2015).

19. Rajni J. and Malaya D. B.: Predictive Analytics in a Higher Education Context. IT Professional, vol. 17, no. 4, pp. 24-33, (2015).

20. Siti Khadijah Mohamad and Zaidatun Tasir.: Educational Data Mining: A Review. Procedia – Social and Behavioral Sciences. Vol. 97, pp. 320-324, (2013).