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TABLE OF CONTENTS

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EDITORIAL

It is my proud privilege to welcome you all to the TheIRES International Conference at Oxford, United Kingdom. I am happy to see the papers from all part of the world and some of the best paper published in this proceedings. This proceeding brings out the various Research papers from diverse areas of Science, Engineering, Technology and Management. This platform is intended to provide a platform for researchers, educators and professionals to present their discoveries and innovative practice and to explore future trends and applications in the field Science and Engineering. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Thus the forum accelerates the trend of development of technology for next generation. Our goal is to make the Conference proceedings useful and interesting to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve the goal.

I once again give thanks to the Institute of Research and Journals, TheIIER, TheIRES & University of Management and Technology (Sialkot) for organizing this event in Oxford, United Kingdom. I am sure the contributions by the authors shall add value to the research community. I also thank all the International Advisory members and Reviewers for making this event a Successful one.

Editor-In-Chief

Dr. P. Suresh
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THE APPLICATION OF DATA MINING TECHNIQUES AS A DIAGNOSTIC TOOL IN FORECASTING THE LEARNING ABILITY OF STUDENTS THROUGH ELECTRONIC MEDIA

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Abstract- This research aims to cast a model developed by the Artificial Neural Network (ANN) in forecasting the learning ability of students through electronic media in the Suan Sunandha Rajabhat University. The neural network technique (Artificial Neural Networks - ANN) is developed with a view to support student by focusing on student and allow student to select the best compatible learning method in both classroom and electronic media contexts. The results show that the most accurate model in this study is the Class-Validation 100 Folds model, accounted for 94.46 % of accuracy. This is because the segmented information is divided into 100 parts. Those 100 parts are alternately employed to teach and test which provide more accuracy that other models.

Index Terms—Artificial Neural Network, Classification, Students.

I. INTRODUCTION

Currently, Suan Sunandha Rajabhat University (SSRU) has organized the curriculum to enforce all undergraduate students to take the Information Technology subject, which is part of the general education (GE). Each class is taught by teachers who are competent in information technology principle. It is a 3 hours class per session which clearly demonstrate the time constraint for the students who might not have sufficient time to clarify their understanding. In addition, the university might not be able to offers an adequate number of teachers to accommodate all students thoroughly.

With the foregoing background, the idea to develop a diagnostic tool for screening and selecting student is emerged with a view to encourage students to choose the appropriate type of class that fit to their learning capability. It was found that most of the students focus on self-learning approach. This is because they mostly believe that they are effective leaner. Moreover, it was found that electronic media is employed to seek for more information and review the knowledge gained during the class. This implies that the usage of electronic media will have a significant influence on self-learning behavior. With the appropriated screening system, students will be able to learn and review knowledge at their own convenience and more often. This also assists the university to arrange the appropriate ration between classroom and number of registered student and to reduce the university cost (e.g. lecturer cost, overtime cost for administrative staff, and any other supportive cost). This will also lead to the decrease in tuition fee which clearly demonstrate the benefit to the student side.

This study employs the online examination results of the undergraduate students in the academic year of 2011, Grade Point Average (GPA), faculty, scholarship condition, educational level, working condition, and wages as variables to develop a set of rule base. The grades in the information technology course during the academic year of 2010 and 2013 are the forecasted results. WEKA program is employed to develop a data mining. The ANN technique is used to stimulate the screening model that can be applied to the new student. The rationale behind selecting the ANN technique is that ANN works as multi-layered process. The model, therefore, makes it possible to create an accurate and comprehensive screening criterion. In addition, it assists researcher to better choose the model that yields the most accurate and select the most appropriate information to analyze. This paper is organized as follows: Section I provides general introduction to the study; Section II describes the related work concerned thisresearch. Section III demonstrated the methodologies used in this study. The experiments and results are shown in Section IV. Finally, Section V concludes the paper.

II. RELATED WORK

At present, data mining has been frequently applied in several contexts, for instance product marketing in department store, financial and banking activity and others. Recently, the usage of this technique is extended to the education context, with a view to investigate various type of information, such as student's personal information (e.g. age, gender, education profile, and GPA). In the past, it was found that there is a limited usage of this data. The data mining techniques that are frequency used in the field of education are the Association Rule Discovery, the Data Classification, and the Data Prediction.

Such techniques are often applied in data mining for educational context. The decision tree is also one of the most popular tools for data classification in data mining. It has compiled a relation data set, including several "Attributes" which will sum up to be "Instance" within a data set. This is applied to develop a screening model to select the best efficient model to achieve the

result which is the Association Rule Discovery. This can be further applied in various ways, for instance forecasting data, identifying the data relationship, as well as supporting the decision making in education context (e.g. enrollment method and identifying the pathway to graduate). The decision tree technique can be moreover integrated with other techniques, for instance the Genetic Algorithm (GA), with a view to improve the accuracy of the result compare with applying the decision tree alone.

The decision tree technique is considered as the most popular technique. Most of the researchers that employ classification technique will select decision tree technique in their research for both analytical purpose and comparison purpose. This is due to the decision tree technique provides the most accurate result, easy to understand, highly flexible, and suitable for data mining, especially for classification technique. Meanwhile, the ANN is developed and validated in several researches. ANN focuses on the identification, screening, and forecasting. The operation process behind this technique is the layers of node, which is effective in classification task, as it is flexible and has limited errors, compared to other techniques. Such technique becomes very popular in Data Mining context. It is considered as a highly effective technique which is therefore suitable to employ in academic research.

III. METHODOLOGY

In this section, we demonstrate the Multilayer perceptron neural network applied in this research.

A. Multilayer perceptron Network

The artificial neural network (ANN) or neural network in short, is inspired by simulating the function of a human brain. A neural network can be used to represent a nonlinear mapping between input and output vectors. Neural networks are among the popular signal-processing technologies. In engineering, neural network serves two important functions, namely pattern classifiers and nonlinear adaptive filters [1], [2]. A general network consists of a layered architecture, an input layer, one or more hidden layers and an output layer [3].

The Multilayer perceptron (MLP) is an example of an artificial neural network that is used extensively to solve a number of different problems, including pattern recognition and interpolation [4], [5]. Each layer is composed of neurons, which are interconnected with each other by weights. In each neuron, a specific mathematical function called the activation function accepts input from previous layers and generates output for the next layer. In the experiment, the activation function used is the hyperbolic tangent sigmoid transfer function [3] which is defined as in equation (1):

$$f(n) = \frac{1 - e^{-2s}}{1 + e^{-2s}} \qquad (1)$$

where $s_i = \sum_{i=1}^{n} w_i x_i$, in which are weights and are input values.

The MLP is trained using the Levenberg–Marquardt technique as this technique is more powerful than the conventional gradient descent techniques [1].

The Levenberg-Marquardt (LM) algorithm [6] is the most widely used optimization algorithm. It outperforms simple gradient descent and other conjugate gradient methods in a wide variety of problems. If a function V(x) is to be minimized with respect to the parameter vector x, then Newton's method would be:

$$\Delta \underline{x} = -[\nabla^2 v(\underline{x})]^{-1} \nabla v(\underline{x}) \qquad (2)$$

where $\nabla^2 v(\underline{x})$ is the Hessian matrix and $\nabla v(\underline{x})$ is the gradient. If $v(\underline{x})$ reads:

$$v(\underline{x}) = \sum_{i=1}^{N} e_i^2(x) \qquad (3)$$

$$\nabla v(\underline{x}) = J^T(\underline{x}) \underline{e}(\underline{x}) \qquad (4)$$

$$\nabla v(\underline{x}) = J^T(\underline{x}) \underline{e}(\underline{x}) \qquad (5)$$

where $J(x)$ is the Jacobian matrix

$$J(x) = \begin{bmatrix} \frac{\partial_{e1}(\underline{x})}{\partial x_1} & \frac{\partial_{e1}(\underline{x})}{\partial x_2} & \cdots & \frac{\partial_{e1}(\underline{x})}{\partial x_N} \\ \frac{\partial_{e2}(\underline{x})}{\partial x_1} & \frac{\partial_{e2}(\underline{x})}{\partial x_2} & \cdots & \frac{\partial_{e2}(\underline{x})}{\partial x_N} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{\partial_{eN}(\underline{x})}{\partial x_1} & \frac{\partial_{eN}(\underline{x})}{\partial x_2} & \cdots & \frac{\partial_{eN}(\underline{x})}{\partial x_N} \end{bmatrix} \qquad (6)$$

And

$$s(\underline{x}) = \sum_{i=1}^{N} e_i \nabla^2 e_i(\underline{x}) \qquad (7)$$

For the Gauss-Newton method it is assumed that $s(\underline{x}) \approx 0$, and equation (2) becomes:

$$\Delta \underline{x} = \left[J^T(\underline{x}) J(\underline{x})\right]^{-1} J^T(\underline{x}) \underline{e}(\underline{x}) \qquad (8)$$

The Lavenberg-Marquardt modification to the Gauss-Newton method is:

$$\Delta \underline{x} = \left[J^T(\underline{x}) J(\underline{x}) + \mu I \right]^{-1} J^T(\underline{x}) \underline{e}(\underline{x}) \qquad (9)$$

The parameter μ is multiplied by some factor (β) whenever a step would result in an increased $V(\underline{x})$.

When a step reduces $V(\underline{x})$, μ is divided by β. When the scalar μ is very large the Levenberg-Marquardt algorithm approximates the steepest descent method. However, when μ is small, it is the same as the Gauss-Newton method. Since the Gauss-Newton method converges faster and more accurately towards an error minimum, the goal is to shift towards the Gauss-Newton method as quickly as possible. The value of μ is decreased after each step unless the change in error is positive; i.e. the error increases. For the neural network-mapping problem, the terms in the Jacobian matrix can be computed by a simple modification to the back-propagation algorithm [7].

IV. EXPERIMENT AND RESULTS

B. Classification of data

The research methodology for designing and developing the screening model begins with the preparation of raw data as an input to WEKA program. Data includes student history, assignment score, attention score, Information technology subject's grade, foundation test result of all undergraduate students of year 2010-2013, accounted for 31,066 students.

The data set includes 11 key factors, namely 1) result of the foundation knowledge of information technology exam, 2) grade point average in high school level (or equivalent), 3) faculty, 4). Scholarship status, 5) Educational level, 6) father's wage, 7) mother's wage, 8), personal disease, 9) health condition, 10) Marital status of parent, 11) the attendance score of Information Technology subject, 12) exam result of information technology subject, 13) overall result of information technology subject. Those factors are used in model forecasting and model developing purposes. However, it is found that there are many missing data in the collected data. The researcher, therefore, applies the missing data reduction technique to overcome such shortfalls in all factors, except 1) exam result, 2) overall result, and 3) grade point average. This is because such data have a significant impact on the accuracy of the model and cannot be neglected.

The missing data is then replaced by using numeric data technique. For example, the average of father's wage is lower than 12,500 baht per month. Such amount will replace all missing data in this category (i.e. in this study, 3,762 missing data are replaced). Similar to the father's wage, the average amount of mother's wage is lower than 12,500 baht per month. This amount replaces 3,525 missing data in this category. After replacing all missing data, there are 20,917 data remaining to be stored for comparison purpose. Then, for another technique (deleting missing data technique), the missing data is deleted. The remaining data accounts for 17,482 data set. This set of data is used for comparison purpose. Two set of prepared data are then tested in all the variables that are relevant to the overall accuracy. Comparison analysis between the replacing model and deleting model is carried out with a view to assess the impact on the accuracy of the result in each model. The output from this stage is used to select the appropriate data set to be modeling afterward. Then, model with the highest accuracy is used to screen students.

C. Result

The results of analyzing related factor using Neural Network technique by implementing Cross Validation 5 fold and Validation 10 fold show that all factors have significant impact on the accuracy of the model. When the missing data is neglected, the accuracy of the model is decreased. Therefore, to obtain the most accurate result, the model requires all related factors, as shown in table 1.

Table 1. The analysis of related factor using Neural Network technique by comparing between Cross Validation 5 fold and Cross Validation 10 Folds

Factor	Accuracy (%) Cross Validation 5 Folds	Accuracy (%) Cross Validation 10 Folds
Overall	**92.14**	**93.76**
Result of foundation exam	90.69	90.73
High school GPA	89.41	92.11
Faculty	88.47	89.34
Scholarship condition	91.69	93.56
Educational level	92.12	93.52
Father's wage	91.68	93.59
Mother's wage	91.90	93.39
Personal disease	92.11	93.52
Health condition	92.11	93.52
Parent's marriage status	82.54	84.97
Attendance score	91.69	93.56
Assignment score	92.11	93.52

The comparison results between replacing missing data and deleting missing data show that both has a significant impact on the accuracy of every model, accounted for an average of 0.477% which is statistically accepted, as shown in table 2.

Table 2. The comparison results between replacing missing data and deleting missing data using Neural Network technique

Model	Accuray of replacing missing data model (%)	Accuracy of deleting missing data model (%)	Diff
5 Folds	92.14	92.32	0.18
10 Folds	93.76	93.60	0.16
100Folds	94.46	94.13	0.33
10 %	89.98	90.87	0.89
20 %	92.12	91.24	0.88
66 %	92.15	92.90	0.75
Separate data of 80/20	93.06	92.91	0.15

This study then uses the replacing missing data model to analyses, as it provides more accurate result, as shown in table 3 below.

Table 3. Model comparison using Neural Network Technique

Model	Accuracy (%)
5 Folds	92.14
10 Folds	93.76
100 Folds	94.46
10 %	89.98
20 %	92.12
66 %	92.15
Separating data of 80/20	93.06

The results show that the most accurate model using Neural Network technique is Cross Validation 100 Folds, accounted for 94.46%. Therefore, the Cross Validation 100 Folds is recommended to be employed in student screening process.

CONCLUSION

The model analysis using Neural Network technique shows that the Cross Validation 100 Folds provides the most accurate result, accounted for 94.46%. This is because the data set is classified into 100 layers before testing. Therefore, it provides in-depth analysis of the data set. However, there are still some suggestions according to this study, especially in the selection and collection factors. If the automatic approach is employed instead of manual approach in collecting data, the data will be more accurate. Because the data filled by people or filling equipment may create a mistake which will then lead to the decrease in accuracy of the model once the analysis is carried out. In addition, GPA, in which the research was divided into three levels, should be divided into more level. This will also lead to more accurate result. The replacing data technique will also only provide a slightly more accurate result compare with the deleting missing data technique. If one can investigate further in this issue and propose a better model to overcome such shortfall, the result would be much more accurate.

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