

Forecasting the Learning Outcomes of the Learning Management Process According to the Study Plan with Artificial Intelligence

Abstract. This study presents the advanced prediction of learning achievement of students in Bachelor of Science in Technical Education, Electrical Program at Rajamangala University of Technology Srivijaya, Songkhla by using the technique of back-propagation neural networks based on the historical data of the pre-semester grade point average (GPA) that is expected to be a relevant factor affecting the cumulative GPA throughout the anticipated undergraduate program used in teaching and testing the neural network model to predict the average grade level. The results of the experiment showed that the use of neural network techniques for forecasting the grade point average obtained can be used to help in the preparation of effective study plan for first-time students.

Streszczenie. Niniejsze opracowanie przedstawia zaawansowaną prognozę wyników w nauce uczniów w Bachelor of Science in Technical Education, Electrical Program at Rajamangala University of Technology Srivijaya, Songkhla przy użyciu techniki sieci neuronowych z propagacją wsteczną w oparciu o dane historyczne z oceny przedsemestralnej średnia punktowa (GPA), która ma być istotnym czynnikiem wpływającym na skumulowany GPA podczas przewidywanego programu studiów licencjackich stosowanego w nauczaniu i testowaniu modelu sieci neuronowej w celu przewidzenia średniego poziomu ocen. Wyniki eksperymentu wykazały, że wykorzystanie technik sieci neuronowych do prognozowania uzyskanej średniej ocen może pomóc w przygotowaniu efektywnego planu studiów dla studentów pierwszego roku. (**Prognozowanie efektów uczenia się procesu zarządzania uczeniem zgodnie z planem nauki ze sztuczną inteligencją**)

Keywords: Learning outcomes, artificial intelligence, forecasting phrases.

Słowa kluczowe: prognozowanie, sztuczna inteligencja, uczenie się.

Introduction

Artificial intelligence is the development of computer systems to behave like human beings, especially learning abilities and sensory capabilities which mimic human learning and decision-making. One of the artificial intelligence goals is to create programs that can understand human languages. For this reason, business organizations and various agencies have brought artificial intelligence into work operation to reduce capital costs, labor and time. Another reason for using artificial intelligence is that it adds value at work as it not only helps business organizations but also promotes and supports the potential of educational organizations, such as using it to forecast the accuracy of the results produced by a large amount of data. Presently, higher education focuses on the development of learners' abilities in searching for new knowledge all the time. These development processes will result in benefits for students' life and future careers. The key to building these competencies for learners is the educational institution which is considered as part of Thai society in its attempt to develop and guide students. Therefore, choosing the field of study in any faculty or program is very important as this requires careful decision making. Learners who select the program properly tend to be more successful in their future careers. Consequently, this leads to the study on forecasting the learning outcomes of the learning management process according to the educational plan with artificial intelligence for Bachelor of Science in Technical Education, Electrical Program at Rajamanagala University of Technology Srivijaya. At present, there are mathematical modelling tools available for forecasting by means of statistical analysis such as linear analysis, regression, and time series analysis. However, these instruments have been found to reach the peak of forecasting capabilities because these tools are linear correlations despite the fact that the relationship between system variables is not linear. Therefore, the outcome data obtained from the prediction is an approximation. Although there are many models used in the analysis, these models

require a lot of data and usability. In addition, the model calibration is often cumbersome using a complex computational process and requiring a simulated user experience [1]. At present, the back-propagation neural network (BPNN) is an increasingly popular model capable of simulating the complex processes of nature. Since the internal structure contains nonlinear functions, the network findings are closest to the system results. This model is increasingly being used in forecasting and predicting outcomes in advance [2].

Therefore, a multilayer feed forward neural network model was created in this research. Back-propagation neural network teaching techniques are used for predicting the pre-score level of the samples of Bachelor of Science in Technical education, Electrical Program at Rajamanagala University of Technology Srivijaya, Songkhla. As the trend of student achievement over the past 3-4 academic years has not been statistically analyzed, the projected results will show the trend of future student achievement. This will lead to guidelines in planning future instruction. In addition, the useful information obtained can be used in deciding whether or not the course contents in each unit of study need to be updated. Besides, it is regarded as a decision aid or support for admission to Bachelor's Degree in Technical Education, Electrical Program at Rajamanagala University of Technology Srivijaya, Songkhla for students finishing their study from Mathayom 6, vocational certificate, and those interested in using information as a guideline for further study. In the present time, there has been a lot of changes in terms of speed and accuracy so the program should be prepared to adapt to new technologies and practices, especially the use of technology in the digital age [3].

Learning Management according to the

Learning management is the intention that results in learning. Good learning management leads to favourable learning outcomes. Teachers play an important role in enabling students to learn as teaching knowledge, skills and

principles helps students learn in a meaningful and valuable way. Nowadays, the learning process is not limited to classroom settings. Therefore, learning management also known as learning activity is so important that teachers should understand and implement it correctly and effectively [4].

1. Curriculum refers to the study of education purpose for understanding course objectives, setting clear learning management [5] targets, and selecting appropriate contents in accordance with local needs.

2. Instruction management means choosing the right teaching method and the learning management technique to help learners achieve the intended learning objectives.

3. Measurement means choosing the appropriate assessment method that yields conclusive results.

4. Learning management evaluation refers to the ability to assess the results of all learning management.

Back-Propagation Neural Networks

In this study, the multilayer feed forward neural network is used to model the data as shown in Fig. 1.

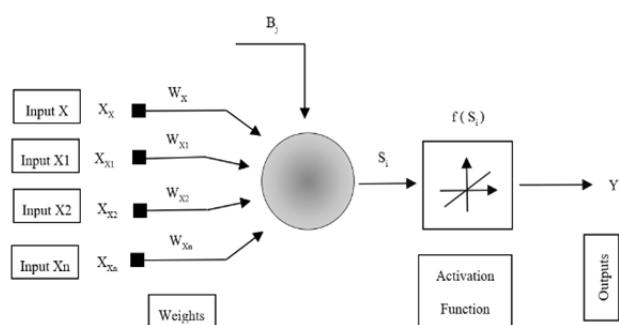


Fig. 1. Multilayer Feed Forward Neural Network

Back-propagation teaching rules are a widely accepted method of teaching multilayer feed forward neural networks. The rules for teaching this method derived from the steepest descent approach in which the minimum value of the objective function commonly used can be defined as: [2], [6]–[8]

$$J(W) = \frac{1}{2} \sum_{i=1, m}^n (Y_{di} - Y_i(W))^2 \quad (1)$$

where: W is the weight of the neural network; m is the size of the output vector; Y_{di} and $y_i(W)$ are the i members of the desired output vector and the actual output vector obtained from the neural network, respectively.

Therefore, the rules for teaching the back-propagation method can be written as follows:

$$W_{k+1} = W_k - \eta \left(\frac{\nabla_w J}{\|\nabla_w J\|} \right) \quad (2)$$

Where η is the positive tuition rate, w_k is the weight of the teaching cycle k ; $\nabla_w J$ is the gradient of the target function at the instructional cycle k . $\|\cdot\|$ is the Euclidean norm sign.

Experiment and Analysis of Results

In conducting this research, a multilayer feed forward neural network model has been tried out and tested using back-propagation teaching techniques to predict the cumulative GPA throughout the bachelor's degree program by means of a purposive sampling method from the 2019-2020 academic years. Records of educational information and GPA were used to experiment as input to the neural network analysis, and the statistical method consisted of various variables as follows: X_0 is the education level of Mathayom 6 vocational certificate. X_1 - X_{48} is the GPA before entering the study. The output data for modelling Y are the cumulative GPA throughout the bachelor's degree program. The predicted data were the GPA throughout the bachelor's degree program in the second semester of academic year 2020. Both input and output data used for modelling and testing were made up of 3,762 formats [1], [4], [9], [10].

The mean absolute percentage error (MAPE) was used to determine the predicted error as displayed in Equation 3.

$$MAPE = \frac{1}{N} \sum \left| \frac{E_{a_i} - E_{f_i}}{E_{a_i}} \right| \times 100 \quad (3)$$

Where E_f is the actual cumulative GPA throughout the course; E_a is the cumulative grade point average obtained from the forecast [3],[11].

A multilayer feed-forward neural network model was created and the back-propagation teaching technique was used to predict the score level of the subject by using input of 49 nodes and 2 hidden layers. Each hidden layer has a total of 10 nodes and an output of 1 node. The inputs used to train neural networks are X_0 - X_{48} variables, and the reference output for coaching is Y as the GPA is accumulated throughout the bachelor's degree program. Both input and output data used in coaching are composed of 3752 formats. The test data comprising 50 patterns were the same data set for the statistical analysis. The test result has a prediction error of 4.573 % [3], [6], [8], [11].

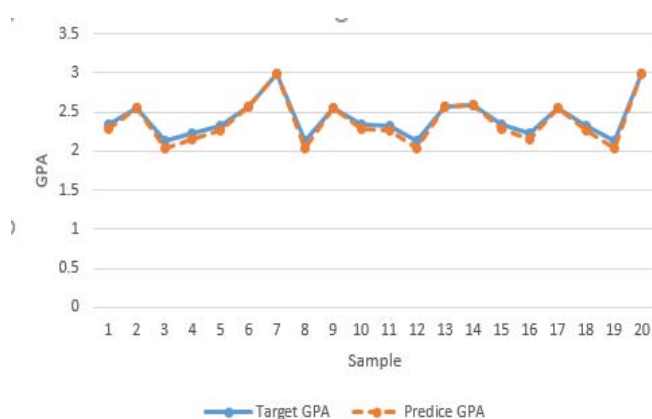


Fig. 2. compares the predicted cumulative GPA to the actual cumulative GPA using 50 data formats.

After the neural network teaching process was completed, a total of 50 test data were imported in a well-learned neural network for predicting the cumulative GPA of graduating students in the 2020 academic year. The forecast results were compared using statistical methods as represented in Fig. 2.

From the experimental results shown in Fig. 2., it can be seen that the use of 350 variables to predict the cumulative grade point average throughout the course by means of the neural network method is close to the cumulative grade point average throughout the course [4]. The predicted values using neural networks were higher than those employing statistical methods. However, both predictions may have some errors due to the high variability of data from other uncontrollable discrepancies. Since the GPA forecast is a prediction of human learning behaviour, it also takes into account historical data used to teach neural networks.

Enough Information is essential as it has an effect on the value data that need to be forecasted.

Conclusions

This research is a comparative study between using the multilayer feed forward neural work method and the back-propagation teaching techniques by means of statistical analysis to create a model capable of predicting the cumulative GPA throughout the bachelor's degree program in advance. It was found that the predicted values from both methods were compared using mean absolute percentage error ((MAPE). Consequently utilizing the neural network method to predict the score level has fewer errors than using the traditional method. However, both methods of forecasting may contain high errors owing to high variability in the data from uncontrolled variances. The scores obtained predict the human learning behaviour, and the historical data employed to tech neural networks should also be taken into consideration. The information obtained should have an adequate level of data for predicting the value needed.

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