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Prediction Of Academic Achievement Of Pamulang University Students Using Artificial Neural Networks

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ABSTRACT

This study aims to develop a prediction model for academic achievement of Pamulang University students using the artificial neural network (ANN) method. Student academic achievement is one of the important factors that reflect the quality of education in higher education. Therefore, accurate predictions can help universities take strategic steps, such as providing more appropriate academic support or designing coaching programs to improve student achievement. This study uses ANN because of its ability to identify complex patterns in data and provide accurate predictions based on the input provided. The data used in this study consisted of various variables, such as exam scores, number of absences, involvement in extracurricular activities, and other factors that influence student academic achievement. The artificial neural network model was trained using historical data of Pamulang University students and then tested to measure the accuracy of the predictions produced. The results of the study indicate that ANN can be used to predict student academic achievement with a high level of accuracy. The developed model shows good potential in helping universities monitor and improve the quality of education, as well as providing a clearer picture of the factors that influence student academic success. Thus, this study suggests the use of artificial neural network methods as a tool in academic information systems to support data-based decision making at Pamulang University, with the hope of improving the quality of learning and overall student achievement.

Keywords: Academic achievement prediction, students, Pamulang University, artificial neural networks, academic information systems.

INTRODUCTION

Student academic achievement is one of the important indicators in assessing the quality of education received in higher education. Every student is faced with the challenge of achieving academic standards set by the institution, which are not only influenced by intellectual ability, but also by various external factors such as motivation, discipline, absence, involvement in extracurricular activities, and social and psychological factors. Therefore, predicting student academic achievement is very important to be able to provide an overview of the possibility of academic achievement in the future.

Pamulang University, as one of the leading universities, is committed to improving the quality of education and providing optimal support for students to achieve the best

achievements. One way to achieve this goal is by utilizing information technology to help the university monitor students' academic development more efficiently and effectively. By utilizing existing academic data, predictions of academic achievement can be made more accurately, so that appropriate policies and coaching programs can be implemented to support students in achieving their academic goals.

In this context, artificial neural networks (ANNs) emerge as one of the methods that have great potential in data-based prediction. ANNs are a machine learning method that can handle complex data and have the ability to find patterns or relationships that are not directly visible between input and output. By using ANNs, academic achievement prediction models can be built by analyzing factors that affect student academic achievement, such as test scores, absenteeism, involvement in campus activities, and other factors.

The application of ANN in predicting academic achievement can provide significant benefits for university administrators in designing more targeted educational strategies. For example, by knowing the prediction of students' academic achievement, the university can provide appropriate interventions, such as academic coaching programs for students at risk of having low achievement or motivational programs to increase students' enthusiasm for learning. In addition, a more in-depth analysis of the factors that contribute to academic achievement can provide valuable insights for improving the learning process at Pamulang University.

This study aims to develop a prediction model for academic achievement of Pamulang University students using the artificial neural network method. By using historical student data covering various variables, such as exam scores, attendance, and involvement in extracurricular activities, this study will build and test a prediction model that is expected to provide a high level of accuracy in predicting student academic achievement. In addition, this study also aims to explore the main factors that influence student academic achievement at Pamulang University, which can later be the basis for designing more effective and efficient educational policies and programs.

Overall, this research is expected to contribute to the development of a data-based academic information system, which is not only useful for educational management at Pamulang University, but can also be used as a reference for other educational institutions in optimizing the prediction of student academic achievement using artificial neural network technology.

RESEARCH METHODOLOGY

This research is a descriptive research, which describes the development processes determined by the researcher. So the stages of the methodology carried out in carrying out this research are as follows:



Figure 2.1 Flowchart of the Research Design Process.

The following is a description of the main steps that can be depicted in a Flowchart:

Identification of Problems and Research Objectives

At this stage, the problem faced, namely the prediction of academic achievement of Pamulang University students, is identified. Determination of the research objective, namely developing a prediction model using artificial neural networks, is also carried out here.

Student Data Collection

The data needed for the research was collected from various sources, such as student academic data (exam scores, attendance, involvement in campus activities, etc.).

Data Preprocessing

At this stage, the collected data is cleaned and further processed. Some of the preprocessing techniques used include handling missing data, data normalization, and converting data to a format suitable for ANN model input.

Data Sharing

The processed data is divided into two parts: training data and test data. Training data is used to train the model, while test data is used to test the accuracy of the trained model.

Artificial Neural Network (ANN) Design

The design of the ANN architecture is done at this stage, which includes selecting the number of hidden layers, the number of neurons in each layer, the activation function, and other parameters relevant to the prediction.

JST Model Training

The ANN model is trained using training data. This training process involves learning from data to find patterns that can be used to predict student academic performance.

JST Model Testing

After the model is trained, the model is tested using the prepared test data. The results of this test are used to measure the model's ability to predict students' academic achievement.

Implementation and Recommendations

After the model was successfully developed and tested, the model was implemented for use in predicting academic achievement of Pamulang University students. Recommendations are given based on the results of the study for improving the education system and further development.

RESULTS AND DISCUSSION

Jupyter Notebook, is used to build a model to predict the academic performance of students. The model building is done after the collected dataset is preprocessed, and the missing data is removed. A neural network library known as Keras is used for the experiment. It is a stacked layer model built into the python programming language that supports multi-layer networks. After the dataset is partitioned and the initial parameters are set, the model is trained for 50 epochs to get the model performance. The neural network performance reaches its optimum point at a performance accuracy of 97.36%. As the model is trained through a certain epoch, the ANN learns and understands the pattern of the dataset. As a result, the loss function value starts to decrease while the accuracy starts to increase. This continues until the end of the epoch. The training value of the model is consistent with the good learning behavior of the neural network. In addition, from the Keras sequential model, and based on the training accuracy and performance, the final model is as shown in Figure 1 above. Generally, the ANN architecture is usually multi-layered and each layer consists of neurons. A pictorial representation of the final neural network model is shown below. It also represents the neural network model for students' academic performance as shown in Figure 3.1 below.

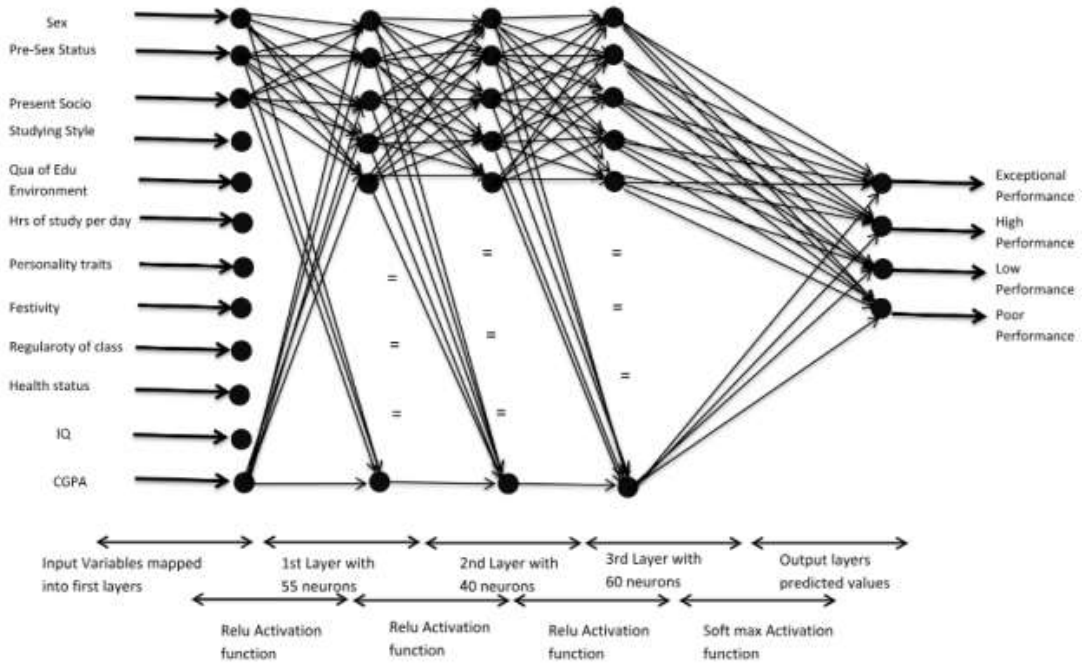


Figure 3.1 Artificial Neural Network Architecture for Student Academic Performance

Model Prediction

The obvious reason for building an ML model is to make predictions; therefore, the final and crucial part of building an ANN model is to predict unseen data called the test dataset. Predicting student academic achievement using the ANN model is a multi-class classification model that produces four outputs/labels based on the model learning through previous training on the input dataset. The four expected output samples from this study are

a. Excellent performance
b. High performance
c. Low performance
d. Poor performance

To make predictions, this work uses a model designed to generate predictions on new data or an unseen dataset called the test dataset by calling a predict function such as predict() on the model. There are four expected classes at the output layer of the ANN model. These are excellent, high, low, and poor performance. These are the labels in the dataset fed into the ANN; however, the strings in this output layer can be simulated and trained with the numeric data in the dataset. From Figure 5 above, a total of 504 (70%) were used as training data, while 216 (30%) samples were used as test data of the dataset. The results in Table 3 show that variables such as the number of hours of study per day, personality traits, celebrations, regularity of attending classes, health status, and IQ have P values <0.05 indicating that statistically, these variables contribute significantly to students' academic achievement outcomes. On the other hand, variables such as student gender, pre-college status, parents' socio-economic

status, learning style, and quality of educational environment have a correlation coefficient or P value>0.05, this explains that these variables are statistically insignificant to student academic achievement based on the dataset used in this JST modeling, namely the level of significance (∞>0.05).

Prediction results

This study predicts students' academic performance using ANN. The ANN model has four layers: an input layer, two middle layers, and an output layer. The twelve input layer variables are mapped to 55 neurons, the two middle layers have 40 and 60 neurons each, and the output layer has 4 neurons representing 4 expected outcome classes, namely excellent performance, high performance, low performance, and poor performance. This academic performance prediction shows optimal performance on three hidden layers of 55, 40, and 60 neurons respectively. The prediction accuracy reaches an optimum of 97.36% and a standard deviation of 0.52%. The two activation functions used are relu and softmax. From the graphical representation above in Figure 6(a), the model starts making correct predictions after epoch 10. The learning phase is smaller compared to the correct prediction phase. This means that the model learns faster to be able to make correct predictions on the data set. The two-color graph shows the performance of the data set partition for the training and testing data sets.

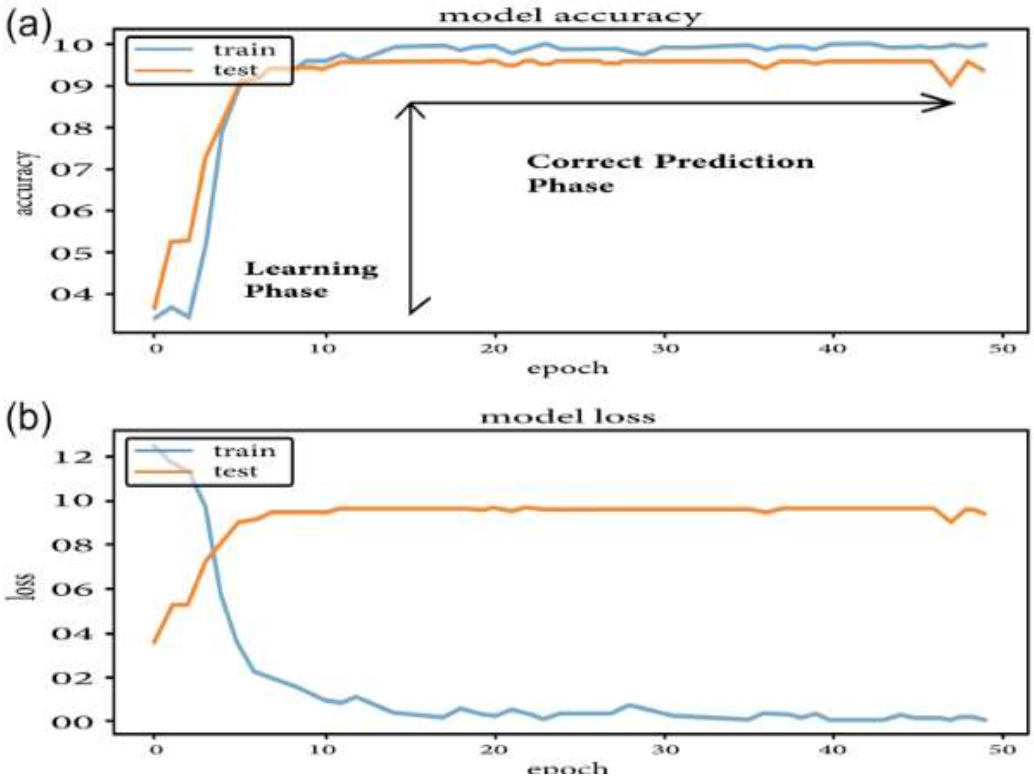


Figure 3.2 (a) and (b): Model accuracy and model loss graphs

1. CONCLUSION

Research on predicting academic achievement of Pamulang University students using the artificial neural network (ANN) method has successfully shown great potential in

helping to predict students' academic results with adequate accuracy. Based on the results of the analysis and model testing, it can be concluded that the use of ANN in predicting academic achievement is able to identify complex patterns and relationships between various factors that influence student achievement, such as test scores, absences, and involvement in extracurricular activities.

Some of the main conclusions from this study are as follows:

1. High Prediction Accuracy

The developed JST model successfully provided predictions with a fairly good level of accuracy. The test results showed that this model could predict students' academic achievement with a low error rate, although there were several factors that affected the overall level of prediction success.

2. The Influence of Different Factors on Academic Achievement

Analysis of the model results shows that factors such as test scores, frequency of absences, and involvement in campus activities have a significant influence on student academic achievement. This data provides valuable insights into areas that need attention to improve academic quality at Pamulang University.

3. Ease of Use of JST

The use of artificial neural networks in this study makes it easier for universities to conduct predictive analysis. The ANN model not only provides accurate predictions, but can also be adapted to various other prediction scenarios that may be useful for academic management.

4. Potential Implementation in Academic Information Systems

With the predictions generated by this model, Pamulang University can develop a more sophisticated academic information system, which can help in designing academic coaching programs and providing support to students at risk of declining performance. This will allow for more targeted and data-driven interventions.

5. Further Development

Although the ANN model showed good results, there is still room for improvement, especially in terms of overfitting and improving model accuracy by using more diverse data and more variables. Further research can be focused on improving the model, by taking into account more factors that affect student achievement, as well as increasing the model's capacity to handle larger data.

Overall, this study suggests that the use of artificial neural networks in predicting academic achievement of Pamulang University students can be a very useful tool for educational administrators to make better data-based decisions. The model developed in this study not only provides better insight into the factors that influence academic achievement, but also opens up potential for further development in data-based prediction systems in education.

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