DECISION SUPPORT SYSTEM FOR PREDICTING STUDENT ACADEMIC PERFORMANCE

1ROSELINE OGHOGHO OSASERI, 2ROSEMARY AGHARESE USIOBAIFO
University of Benin
NIGERIA
Email: 1roseline.osaseri@uniben.edu, 2rosemary.usiobaifo@uniben.edu

ABSTRACT

The prediction of students’ academic performance and early recognition of their weaknesses can warn them in advance and guide tutors in providing counseling and additional support. As a result, it has the potential to reduce the risk of the student achieving an unacceptable Grade Point Average (GPA) that could lead to withdrawal from the institution. In this paper, a machine learning approach was used to model a decision support system for predicting student academic performance. The proposed model was developed and simulated in MATLAB environment. It is expected that results of this study would help the management of academic institutions in admission decision processes.

Keywords: Machine Learning, Academic Performance, Prediction, Student Admission

1. Introduction

Performance is defined as an observable or measurable behavior of a person or an animal in a particular situation usually experimental situation, it measures the behaviors or an aspect of a feat that can be observed over a period of time (Simpson & Weiner, 1989; Adedeji, 1998). The relevance of student performance can never be over emphasized; hence student performance is a major criterion by which the effectiveness of any educational institution could be judged (Simpson & Weiner, 1989; Adedeji, 1998). The prediction of student academic performance has long been an important research topic among other issues of higher institutions. Undergraduate Students academic performance is one of the current educational challenges facing our higher institutions of learning in Nigeria. Effort to mitigate the trend of student poor academic performance has given birth to various admission processes such as Post-Unified Tertiary Matriculation Examination (PUTME).

The main objective of admission processes is to determine the candidates who would likely perform well after being accepted into the university. The ability to predict student academic performance and early recognition of the students’ weaknesses can warn the students in advance and guide tutors in providing counseling and additional support, thereby reducing the risk of the student having an unacceptable Grade Point Average (GPA) that could lead to withdrawal from the institution and also increased the quality of the students’ academic performance. In this paper a machine learning approach is used to model a decision support system for predicting student academic performance. The remain part of the this paper will be organized as follows, a review of machine learning and related literature in predicting student academic performance, materials and method, data preprocessing step, the proposed model and result and discussion.
2. Review of Related Literature
Several researchers have conducted studies on students’ academic performances and so many others have carried out a scholarly research on prediction of academic performance of students (Karamouzis & Vrettos, 2009; Siraj & Abdoulha, 2009)

A study carried out a study in order to evaluate the performance and usefulness of different classification algorithms for predicting students’ final marks based on information in the students’ usage data in an e-learning system. The purpose of the study is to classify students with equal final marks into different groups depending on the activities carried out in a web-based course. Data on 438 students from Cordoba University, in 7 Modules (security and hygiene in the work, projects, engineering firm, programming for engineering, computer science basis, applied computer science, and scientific programming) were used for this study. The study shown that some algorithms improve their classification performance when preprocessing task as discretization and rebalancing data is applied and also indicated that a good classifier model has to be both accurate and comprehensible for instructors (Romero, Ventura, Hervás & Gonzales, 2008)

A fuzzy logic approach model was proposed to predict the risk status of students based on some predictive factors. The dataset was collected from a university in north central, Nigeria. The data comprised of 37 records of candidates that were offered admission to study Computer Science. The simulated model shows some degree of risk associated with their past academic achievement (Adeleke, Ruzaini & Hongwu, 2013).

A study carried out by Chen, Hsieh & Do, (2014) employed the feed-forward neural network to predict student academic performance. The study used two meta-heuristic algorithms, including CS and COA, based on the lifestyle of cuckoo birds to train ANNs for predicting students’ academic performance. The simulation results were analyzed to investigate the prediction ability of the neural network trained by these two algorithms. The ANN-COA was found to have slightly better results for predicting student academic performance. A similar study was carried out to analyzed students learning behavior to check the performance of students and predict weak student using K-Means Clustering (Ayesha, Mustafa, Sattar, & Khan, 2010).

3. Material and Method
In this study we adopted the datasets from Adeleke et al. (2013). The datasets was collected from a university in north central, Nigeria. The data comprised of 37 records of candidates that were offered admission to study Computer Science. The data sets consist of four attributes which are secondary school result strength, number of sittings in secondary school examination, entry mode, and parents’ literacy status as depicted in Table 1. In this paper Artificial Neural Network (ANN) algorithms is applied to predict Predicting Student Academic Performance. The proposed model is to predict each class of student data into one of the five prediction class, which include; very low risk, low risk, medium risk, high risk and very high risk. In this study matlab tool was used to simulate the proposed model and classification technique was used to train the netw. 70% of the data set was used to train the network while 30% in the testing phase.

3.1 Artificial Neural Network
Artificial neural networks are computational paradigms based on mathematical models that unlike traditional computing have a structure and operation that resembles that of the mammal
Brain. Artificial neural networks or neural networks for short, sometimes called connectionist systems are networks of systems of simple processing elements or nodes capable of processing information in response to external inputs. Neural Networks learn by evaluating changes in input. Learning can be either supervised or unsupervised. One of the advantages is its capability of learning and high computational power. ANN works well with noisy data and is capable of processing numeric and categorical data. It is considered an efficient classifier in several domains and is widely used for supervised learning and unsupervised clustering (Walczak, 2005).

**Table 1: PREDICTIVE ATTRIBUTES**

<table>
<thead>
<tr>
<th>S/N</th>
<th>ATTRIBUTES</th>
<th>DESCRIPTION</th>
<th>RANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SSRS</td>
<td>Secondary school result strength</td>
<td>1-6</td>
</tr>
<tr>
<td>2</td>
<td>NSSSE</td>
<td>Number sitting in secondary school examination</td>
<td>1-2</td>
</tr>
<tr>
<td>3</td>
<td>EM</td>
<td>Entry mode</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>PLS</td>
<td>Parent literacy status</td>
<td>1-2</td>
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4. Result and Discussion

In order to achieve a high degree of accuracy in the prediction of student academic performance, we proposed a mathematical model with the capability of learning and high computational power as a classification algorithm. The network consisted of the training and testing phase, 70% of the data sets were used for training while 30% for the testing and validation phase as represented on Figure 1. The network consisted of 8 inputs parameters with 20 hidden layer 1 output layer as shown in Figure 2, the network performance is depicted in Figure 3.

![Training and testing phase](image-url)
Fig. 2: Network layers

Fig. 3: Network performance
5. CONCLUSION
The prediction of students’ academic performance and early recognition of the students' weaknesses using Artificial Neural Network as classification tool in soft computing; can warn the students in advance and guide tutors in providing counseling and additional support, thereby reducing the risk of the student having an unacceptable Grade Point Average (GPA) that could lead to withdrawal from the institution and also increased the quality of the students’ academic
performance. Thus the result of this study will help the management of academic institutions in admission decision processes and a better teaching approach.

6. References


