Student Performance Prediction using Machine Learning Algorithms: A Review

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ABSTRACT
Today's students are tomorrow's future. It is important to invent a method to help each student "be all they can be!" .[11]Since it is used to assess how effectively educational institutions' programs are operating, student performance is obviously important to both students and institutions.. [11] The majority of institutions or departments consider student academic success to be their primary objective for the coming year, thus they implement their tactical plans to that end. Today's era is a digital er ,so there is a lot of online information's about students. Large amounts of online and offline learning data that students have left behind make it possible to anticipate their performance and to pre-intervene with at-risk kids, using data mining, machine learning, and deep learning to predict student achievement.[1] These methods can help the student as well as teachers to get the best results. These methods of analyzing using data can be used to identify the areas where students are falling short or excelling. Therefore, it will be beneficial for both students and teachers to understand their progress. [1]It aids teachers and supervisors in monitoring students to support them and integrate training programs to get the best results, in addition to forecasting students' performance..

Keywords
Student performance, education, deep learning, data mining, machine learning

1. INTRODUCTION
Education plays a vital role in our life and it is crucial to receiving a proper education.[2] Every child could experience a major shift as a result of it. In today's era, knowing every aspect is important for being up-to-date and keeping up with educational breakthroughs is among the most crucial things. The usage of learning management systems is one of these developments. An intuitivA learning management system provides an intuitive, centralized approach for controlling all of a school's or college's online activitytional institution's success is based on the performance of its pupils. For improvements in a variety of student qualities, such as final grades, attendance, etc., student performance prediction and analysis are important. This forecast aids teachers in identifying poor kids and helping them raise their test scores by various data mining methods, deep learning algorithms including clustering, and classification.[4] When we preach student outcomes, we assume unknown values of the variables that identify students. The most predicted values in education are students result, grades, knowledge and scores. Student performance prediction is a very popular application for in – depth research and the data retrieval in the educational sector. A variety of methods and models are used to predict and analyse student work, such as decision tree, neural networks, LSTM etc .This analysis is useful for forecasting a student's performance, such as predicting a student's success in a course and predicting a student's final grade using attributes extracted from logged data. From lessons and assignments to evaluations and grading, these systems allow all components of a course to be kept within oneplace. This implies that teachers can provide comments at any moment on any assignment or exam. Students don't have to wait until the end of the semester to see their grades. In many institutes around the nation, this kind of approach is already being used, and both students and instructors can gain from it. It can be utilized by both teachers and students to aid in the education process, which can be regarded to be beneficial.[9]

Understanding and analysing students' academic performance determinants, as well as projecting their employability using powerful tools such as data mining techniques, can provide useful information for policymakers and solution developers. The vast amount of data acquired from students by the Institute can be a rich source of important information, and data mining techniques can discover hidden patterns. As a result, these priceless findings can assist students and teachers in meeting industry standards and producing high-quality graduates.[2]

Teachers will have more time to work with children on critical thinking and analysis abilities as a result of this. This would also allow teachers to focus on specific kids who could benefit from their help. Student can also see their own report and enthusiast to the success in specific manner. This can help teachers by providing relevant information about the student overall learning process , habits and delivering immediate feedback to students who need more practice with specific topic or skills. It can helpful to teacher's or guides too by helping them to know which topic should be covered ,more valued and plan to make proper assignments which help the student to overcome their difficulties.

It will aid parents who are constantly concerned about their children's academic achievement since they will be aware of their children's performance as well as the areas in which they are deficient. They can now track their students' online interactions more carefully than ever before thanks to technological advancements. It provides access to teachers and student 24 hours a day, 7 days a week, from any location. It can be used as an educational tool that uses algorithms to provide individualized feedback on homework, quizzes, and other assignments. Artificial Intelligence has the ability to make everyone's life easier by automating tedious tasks soyou don't have to. This is the smart way to do work and keep an eye on every details .[2]

Education's future has arrived! It is a critical driver of educational transformation. There are numerous advantages to this. Every student, regardless of learning ability or disability, will have equitable access; this is significant because not all children learn at the same rate or have identical skill sets.

Students can brighten their future with the use of strategies.

2. LITERATURE REVIEW

A framework for determining student trends based on the results of both tangible and intangible records and surveys is presented by Rucha Chaudhari ,KomalJirage, Anil Patthe , Varsha Gupta and Disha Maind..K-means data mining techniques used on the collected data. Trend will be recognized as a consequence of the k-means algorithm. This pattern will allow us to see where kids flourish and where they do not, as well as what qualities they havethat can be developed. The result of the analysis will be summarized, and pupils will be classified depending on the outcome. In this survey ,used technology is detect the following features of student specific interests. . To prepare our students to make a significant contribution to society's technological, economic, social, and entrepreneurial advancement.

For predicting engineering student performance in January 2013 , Mrinal Pandey and Vivek Kumar Sharma has compared the J48, Simple Cart, Rep-tree, and NB tree algorithms. They used 524 students' dataset for 10 fold cross validation and 178 students' data for the percentage split technique. Using the 10-fold cross validation approach, it was discovered that the J48 decision tree algorithm had a greater accuracy of 80.15 percent. The J48 algorithm achieves a greater accuracy of 82.58 percent by applying the percentage split approach. In both circumstances, J48 outperforms other algorithms, according to the results of this comparison. Teachers can utilize the J48 decision tree algorithm to help pupils improve their grades.

Azwa Abdul Aziz, Nor Hafieza Ismail, and FadhilahAhmad (September 2014) used nave bayes, rule-based, and J48 decision tree algorithms to analyse 399 student records. For the evaluation, they used cross validation and the percentage split approach. In % split technique training, the following percentage splits were tested: 10:90, 20:80, 30:70, 40:60, 50:50, 40:60, 30:70, 20:80, 10:90. Following a study of three classification algorithms, it was discovered that the rule-based and J48 decision tree methods have a greater accuracy of 68.8%.

Computational Intelligence Enabled Student Performance Estimate in the Age of COVID 19 was investigated by Vipul Bansal, Himanshu Buckchash, and Balasubramanian Raman (November 2021).The datasets included a collection of distinct evaluation features for students' final score estimation. Considering input grades as sequential data, recurrent neural network (RNN) versions such as long short-term memory and gated recurrent unit (GRU) were employed for temporal evaluation. They used Variational Bayes' encoding for extensive feature extraction with machine learning classifiers to evaluate the datasets, with the R2 -score, MAE, MSE, and RMSE of 0.947, 3.385, 17.279, and 4.154, respectively, indicating that minimum error was obtained using VAE in conjunction with Linear Regressor.[9]

The data of 50 pupils were analysed by Ramanathan L, Saksham Dhanda, and Suresh Kumar D (June-July 2013). For evaluation, they employed nave Bayes, J48, and a devised approach (Weighted ID3). It indicates that WID3 has a 93percent higher accuracy than J48 and nave Bayes. WID3 canbe used to create user-friendly software in the future, which will be extremely beneficial to teachers.

Bo Guo, Rui Zhang, Guang Xu, Guangming Shi, and Li Yang have presented a deep learning architecture for forecasting student performance that takes advantage of unlabelled data by learning many levels of representation automatically. This approach uses a sparse autoencoder to pre-train the hidden layer of the features layer, and then uses supervised training to fine-tune the parameters. The proposed strategy was tested on a pretty large real-world student dataset, and the experimental findings suggest that it is effective.

3. DIFFERENT METHODS/APPROACHES

3.1 By Datamining Techniques

There are many different tools, methods, and strategies used in educational data mining. The most prevalent uses include association, prediction, grouping, and classification. The most popular data mining techniques are neural networks, decision trees, regression analysis, and cluster analysis.

3.1.1 Classification

Classification is a data mining tool that divides up the objects in a collection into specific groups or classes. To correctly forecast the target class for each case in the data is the aim of classification. For instance, a classification model may be used to classify loan applicants as having low, medium, or high credit risks. n a list of classes or topics to focus on The goal of classification is to accurately predict the target class for each case in the data. For instance, a classification model may be used to classify loan applicants as having low, medium, or high credit risks.

3.1.2 Clustering

Clustering analysis is a technique for grouping comparable data into previously undefined clusters. It's beneficial for identifying homogenous groups that can be utilized as input for other models during the data pre-processing phase. Cluster analysis, like classification, can be used to look into similarities and differences across students, courses, professors, and so on.[1]

3.1.3 Prediction

Calculated assumptions for particular events are made based on available processed data in the form of predictions. The regression technique can be used to model the relationship between one or more independent variables and dependent variables to make predictions. The independent variables are the characteristics that are previously known, while the response variables are the ones that we want to anticipate. It can be used for business planning, trend analysis, financial forecasting, time series prediction, and trend analysis, among other things. It is used in the educational industry to forecast student academic performance, enrolment, final grade, degrades, and other things.[1]

3.1.4 Association

A data mining technique called association assesses the chance of components in a collection occurring together. The connections between items that frequently occur are known as association rules. Association rules are commonly used to analyze sales transactions. This kind of data is helpful for catalog design, cross-sell marketing, industry trend identification, and sales promotions. If specific guidelines are followed, this technique can be utilized to launch new schools or provide new courses. A decision tree is a class discriminator that divides the training set recursively until each partition primarily or exclusively contains samples from one class. A split point, which is a test on one or more characteristics and decides how the data is partitioned, is present in each non-leaf node of the tree. [1]

3.2 By Deeplearning Techniques

3.2.1 Conventional Neural Network

The capacity of CNN's algorithm to distinguish many entire behaviors has made it widely used in all fields of picture recognition. As a result, its use has been broadened to cover the education and learning prediction process. In this sense, CNN is analogous to a neural network in that it is made up of connected and numerous neurons arranged in a hierarchical structure, with the layered structure being completed by training. Each layer in the network can share the weight for each neuron, allowing weight to control the layers in the network. DNN differs from one network *to* another in connection, such as deep brief network, backpropagation, and sparse autoencoder; each layer in the network can share the weight for each neuron, allowing weight to control the layers in the network. CNN is used to predict student behavior by extracting new features at a certain time point, and the features takes into account the characteristics from the previous point view.[8]

3.2.2 Recurrent Neural Network

It is one of the neural network methods that work well with data sequences. The capacity to memorize the prior state for use in the present or next state is one of the best features of this method.[6] There are dynamic input and output layers in addition to the hidden layer; inside the hidden layer, there are input and output cases indicated by the output weight from one node to another. Due to connection and feedback routes in hidden layers, the advantage of such algorithms during training is that they are suited for prediction.[1]

3.2.3 Long Short-Term Memory

Its model is described as an RNN version. The value of this method is the self-loop formed in the hidden layers, which automatically builds paths during system execution in addition to generating short paths in each iteration. It's similar to DNN, but with a difference in how the weight that impacts the sort path in the neural network is updated[4].

3.2.4 Deep Neural Network

It's a neural network that has multiple hidden layers. Its model is more effective when dealing with complex data and nonlinear functions.[5] This sort of deep learning can akapttoany changes in the hidden layers during training, as long as the backpropagation algorithm is used. DNN is suitable for education deep learning prediction because it is good with scalable data in prediction models that use complicated data.[1]

4. PROPOSED WORK

We can also use a voting classifier, which allows us to test a variety of algorithms on a dataset and then selects the best algorithm among them that is appropriate for a given dataset.

5. CONCLUSION

Data mining techniques and deep learning techniques both are useful in their ways . There are various open tools that we can use for data mining and get a more visual view of the features affecting student performance.In deep learning identification and prediction can be done on a higher level with lots of data.To construct hidden layers in a neural network, you must first extract valuable characteristics and weights for each one. We employed two models, Adams and RMS prop, to help thesystem perform better and boost forecast accuracy. This can also build and improve the teachers guides of teaching.

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