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SMART AI-BASED STUDENT PERFORMANCE PREDICTION SYSTEM USING MACHINE LEARNING

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Abstract : Educational institutions generate large volumes of academic data, but much of it remains unused for improving student outcomes. Machine learning techniques provide an opportunity to analyze this data and predict student performance effectively. This research proposes an intelligent AI-based prediction system that applies machine learning algorithms to analyze student academic behavior and forecast performance. The system processes attendance, assignments, internal marks, and examination results to identify patterns affecting academic success. Experimental results indicate that the proposed model helps educators identify at-risk students at an early stage and take corrective actions. The study highlights the importance of artificial intelligence in modern educational analytics.

IndexTerms - Machine Learning, Student Performance Prediction, Educational Data Mining, Artificial Intelligence, Data Analytics

INTRODUCTION

Educational institutions increasingly rely on data-driven approaches to improve academic performance and institutional effectiveness. Artificial intelligence and machine learning technologies have transformed traditional educational systems by enabling intelligent analysis of student-related data such as attendance, assessments, assignments, and examination records. However, in many institutions, this data remains underutilized due to lack of analytical tools.

Predicting student performance at an early stage plays a crucial role in providing timely academic support and personalized learning interventions. Machine learning algorithms are capable of analyzing historical academic data and identifying hidden patterns that influence student success. This study proposes a smart AI-based system for predicting student performance to assist educators in improving academic outcomes and overall educational quality.

NEED OF THE STUDY.

RESEARCH METHODOLOGY

With the rapid expansion of educational institutions and increasing student enrollment, managing academic performance manually has become challenging. Identifying academically weak students at an early stage is difficult without automated systems. Traditional evaluation methods fail to provide predictive insights that could help educators intervene before students underperform.

An intelligent student performance prediction system can assist institutions in monitoring academic progress, improving teaching strategies, and providing personalized learning support. Therefore, the need arises for an AI-driven system that can analyze student data efficiently and predict academic outcomes accurately.

Population and Sample

The population of the study consists of student academic records collected from educational institutions. The dataset includes attendance records, internal assessment marks, assignment scores, and previous semester results. A representative sample of student data is selected for training and testing the machine learning models.

Data and Sources of Data

This study uses secondary data collected from institutional academic databases. The dataset contains historical student records that span multiple academic terms. The collected data is used for model training, testing, and performance evaluation.

Theoretical framework

The study includes dependent and independent variables. Student academic performance is treated as the dependent variable, while attendance, internal marks, assignments, and previous academic results are considered independent variables influencing performance.

Machine Learning Models

The following machine learning algorithms are applied in this study:

- Decision Tree
- Logistic Regression
- Random Forest

The models are trained using historical student data and evaluated based on prediction accuracy.

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

IV. RESULTS AND DISCUSSION

I. THE EXPERIMENTAL RESULTS DEMONSTRATE THAT MACHINE LEARNING MODELS CAN EFFECTIVELY PREDICT STUDENT ACADEMIC PERFORMANCE. AMONG THE TESTED MODELS, THE RANDOM FOREST ALGORITHM ACHIEVED THE HIGHEST ACCURACY, FOLLOWED BY DECISION TREE AND LOGISTIC REGRESSION MODELS. THE RESULTS INDICATE THAT ENSEMBLE-BASED MODELS PERFORM BETTER DUE TO THEIR ABILITY TO HANDLE COMPLEX DATA PATTERNS.

II. ADVANTAGES

III. EARLY IDENTIFICATION OF ACADEMICALLY WEAK STUDENTS

IV. IMPROVED ACADEMIC MONITORING AND EVALUATION

V. DATA-DRIVEN DECISION MAKING

VI. ENHANCED TEACHING AND LEARNING STRATEGIES

VII. LIMITATIONS

VIII. REQUIRES LARGE AND HIGH-QUALITY DATASETS

IX. DATA PRIVACY AND SECURITY CONCERNS

X. MODEL PERFORMANCE DEPENDS ON DATA ACCURACY

FUTURE WORK

Future enhancements may include the use of deep learning techniques, real-time academic monitoring systems, integration with Learning Management Systems (LMS), and development of mobile applications for teachers and students.

CONCLUSION

This research demonstrates the effectiveness of machine learning techniques in predicting student academic performance. The proposed smart AI-based system enables educational institutions to utilize academic data more efficiently and support students in achieving better learning outcomes. Implementing such intelligent systems can significantly enhance modern teaching and learning processes.

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