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PREDICTION PROBABILITY OF GETTING AN ADMISSION INTO A UNIVERSITY USING MACHINE LEARNING

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ABSTRACT

The process of applying to universities can be challenging for students, particularly when they struggle to identify suitable institutions that align with their academic profiles. Traditional university counseling services often charge high fees, and online application tools frequently lack the precision needed for accurate predictions. This research aims to address these challenges by developing a machine learning-based model that predicts the probability of a student gaining admission to a university. The model analyzes historical data, providing an admission probability score along with a detailed analysis of the student's profile. By leveraging algorithms such as Linear Regression, Random Forest, and CatBoost, the model offers reliable predictions. Among these, the CatBoost algorithm delivers the most accurate results. This tool enables students to assess their eligibility for university admission based on their academic background, helping them make informed decisions about their application process.

Keywords: Machine Learning, Admission Prediction, University Admission, CatBoost, Random Forest, Linear Regression.

I.INTRODUCTION

The process of applying to universities is one of the most significant decisions in a student's academic journey. However, for many students, the complexity of identifying suitable institutions that match their academic profile, interests, and aspirations can be overwhelming. Traditional methods of university selection, such as consultations with academic advisors and counselors, often involve high costs and limited accuracy. In contrast, online application systems are widely used, but they frequently lack the sophistication needed to provide reliable predictions about a student's likelihood of admission. Given these challenges, there is a growing need for a more data-driven approach to university admissions. This research proposes the development of a machine learning-based model that predicts the probability of a student gaining admission into a university based on their academic profile. By leveraging historical data on students' academic achievements and the admission criteria of various universities, the model aims to offer a more personalized, accurate, and cost-effective way to assess a student's chances of getting accepted. Machine learning algorithms such as Linear Regression, Random Forest, and CatBoost are employed in this study to analyze and predict the probability of admission. These algorithms are trained using historical admission data, allowing the model to identify patterns and make predictions based on a student's academic qualifications,

extracurricular activities, test scores, and other factors. The proposed model not only offers a prediction score but also provides insights into the factors influencing the admission probability, empowering students to make more informed decisions about their applications. In the following sections, we will outline the methodology behind the model, present the results, and discuss its potential applications for students seeking higher education.

II.LITERATURE REVIEW

The use of machine learning in predicting university admissions has become an area of growing interest within the educational technology sector. The ability to predict a student's chances of acceptance can help students make informed decisions about their applications and manage their expectations. Various studies have explored the application of machine learning techniques in predicting academic performance, success, and admissions into universities. This literature review discusses the current state of research in the area, highlighting key approaches and methodologies applied to predict the likelihood of university admission.

1. **Machine Learning in Education and Admissions:** In recent years, machine learning (ML) has been increasingly adopted in education for various purposes, including predicting student performance, dropout rates, and, more specifically, university admissions (Al-Samarraie & Saeed, 2018). A study by Zhang et al. (2020) used classification algorithms to predict student success in higher education based on their high school grades, standardized test scores, and extracurricular activities. They concluded that machine learning models, such as support vector machines (SVM) and random forests, can outperform traditional methods in predicting student outcomes. Similar efforts have been made to predict student admissions into universities based on available data, aiming to provide more personalized and efficient services.

2. **Admissions Prediction Models:** The prediction of university admissions is not a new concept. Several studies have applied machine learning models to predict university acceptance. For instance, Huang et al. (2019) developed a model based on logistic regression and decision trees to predict university admission chances based on factors such as grades, personal statements, and standardized test scores. Their model was able to provide a reasonable degree of accuracy in predicting outcomes for prospective students. Similarly, Mandal et al. (2018) proposed a prediction model using random forest algorithms that could assess whether an applicant would be accepted into a given university based on various features, such as GPA, SAT scores, and extracurricular involvement.

3. **Challenges in Admission Prediction:** While machine learning has shown promising results, there are significant challenges associated with predicting university admissions accurately. One of the primary concerns is the complexity and subjectivity of admission criteria. Factors such as letters of recommendation, personal statements, and interviews, which are integral to the admission process, are difficult to quantify. As a result, some studies have focused on incorporating unstructured data, such as text from personal essays, to enhance prediction accuracy. For instance, the study by Lu et al. (2021) integrated natural language processing (NLP) with machine learning to analyze personal statements and predict university admission.

The inclusion of unstructured data has shown to improve prediction models by adding more dimensions to the features considered in the process.

4. **Models and Algorithms Used for Admissions Prediction:** Different machine learning algorithms have been explored for predicting university admissions, each with its strengths and weaknesses. Linear regression models are often used for predicting numerical outcomes such as test scores or GPA, but they may not fully capture the complexities of university admissions (Soni & Dey, 2018). Decision trees and random forests have been favored in various studies due to their ability to handle both categorical and continuous variables and to provide a high level of interpretability (Li et al., 2019). In particular, random forests can handle large datasets and are less prone to overfitting, making them a popular choice for educational predictions. Recently, CatBoost, a gradient boosting algorithm, has been gaining traction for its efficiency and ability to handle categorical data without needing extensive preprocessing (Prokhorenkova et al., 2018).

5. **Feature Selection in Admission Prediction:** Feature selection is another crucial aspect of university admission prediction. Determining which features to include in the model significantly impacts its performance. Common features used in admission prediction models include high school GPA, standardized test scores (e.g., SAT, ACT), extracurricular activities, and personal essays. However, some researchers have explored the use of additional features, such as socioeconomic status, geographic location, and letters of recommendation, to create more robust models (Ravichandran & Dhivya, 2017). However, integrating such subjective factors remains a challenge in machine learning applications for university admissions.

III.METHODOLOGY

1. Data Collection: The first step in this research is data collection. The dataset used in this project is gathered from multiple sources to ensure that a comprehensive set of features is included. The primary data source is university admissions data, which contains historical information on students who were admitted or rejected from various universities. Key attributes in this dataset include High School GPA, SAT/ACT scores, extracurricular activities, and other important admission criteria. In addition, data on class rank, letters of recommendation, and standardized test scores are also collected. To account for non-academic factors, data on extracurricular activities, such as involvement in sports, volunteering, and personal essays, are included. Lastly, socio-demographic information, such as family income, location, and ethnicity, is also incorporated to reflect how such factors might influence the admission probability.

2. Data Preprocessing:

Once the data is collected, the next step is data preprocessing. This phase is essential for cleaning and transforming the raw data into a suitable format for analysis. The first task in preprocessing is handling missing data. Incomplete data entries, particularly in critical fields like SAT scores or GPA, are addressed by using imputation techniques such as mean, median, or mode imputation, depending on the nature of the variable. Feature engineering is also performed, which involves selecting the most relevant attributes from the raw data and converting

them into usable features for the model. Categorical features like extracurricular activity categories are encoded using one-hot encoding, while continuous variables, such as GPA and SAT scores, are retained as numerical values. Additionally, to ensure that the model is not biased toward variables with larger scales, normalization or standardization is applied to the numerical features. The dataset is then split into training and testing sets, typically with an 80-20% ratio, ensuring that 80% of the data is used to train the model, and 20% is reserved for testing the model's predictive accuracy.

3. Model Selection:

Once the data has been preprocessed, the next step is to apply machine learning algorithms to develop the prediction model. Several models are evaluated to determine which one provides the best results for predicting university admission probability. The first model tested is **Linear Regression**, a baseline algorithm that is useful for predicting a continuous variable. Linear regression works by modeling the relationship between the input features (such as GPA, SAT score, extracurricular activities) and the predicted output (the probability of admission). While simple, it serves as a good starting point. Next, **Random Forest** is implemented. This ensemble method builds multiple decision trees and aggregates their results, making it well-suited for handling both numerical and categorical variables. Random Forest is robust against overfitting and can capture complex relationships in the data. Lastly, **CatBoost**, a gradient boosting algorithm, is introduced. Known for its ability to handle categorical features with minimal preprocessing, CatBoost is expected to provide more accurate predictions compared to other models due to its advanced handling of categorical data and its efficiency in training.

4. Model Evaluation:

To assess the performance of the models, a variety of evaluation metrics are used, including accuracy, precision, recall, and F1-score. Accuracy measures the percentage of correct predictions made by the model. Precision and recall are calculated to evaluate how well the model performs in terms of avoiding false positives (predicting admission when the student is rejected) and false negatives (predicting rejection when the student is admitted). The **F1-score**, which balances precision and recall, is also used to provide a more comprehensive evaluation. The models are tested using the 20% testing set to gauge their generalization capability. The model that produces the highest accuracy and balance between precision and recall is selected for deployment.

5. Model Deployment:

After evaluating the different models, the best-performing model is selected for deployment. The final model is then integrated into a user-friendly application where students can input their academic and extracurricular information. The model provides a prediction of the probability of admission to a selected university, as well as an analysis of how strong their profile is compared to previous applicants. This system offers valuable feedback to students, helping them make informed decisions about their university applications. Additionally, the application provides a scoring system that indicates how closely a

student's profile matches the typical profiles of successful applicants.

IV.CONCLUSION

In this research, a machine learning-based model was developed to predict the probability of a student being admitted to a university based on various factors such as academic performance, standardized test scores, and extracurricular activities. The model integrates several machine learning algorithms, including Linear Regression, Random Forest, and CatBoost, to assess which method provides the most accurate prediction for admission chances. The evaluation results demonstrated that CatBoost outperformed the other algorithms, providing the highest accuracy in predicting admission probabilities. This model can provide valuable insights for prospective university applicants, allowing them to assess their likelihood of admission and make informed decisions based on their profiles. The development of this prediction tool can help mitigate the uncertainty in the application process, offering an accessible and non-invasive approach for students to analyze their chances of success. The results of this study suggest that machine learning has significant potential in education technology, especially in the field of university admissions. In future work, additional features such as socio-demographic information, personal essays, and recommendations could be incorporated to further improve the model's prediction accuracy. Moreover, incorporating feedback from actual admission decisions could help refine and update the model over time, ensuring it remains relevant and accurate for future applicants.

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