PROACTED: An AI-Driven Course Recommender, Academic Performance Monitoring and Intervention Model

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Introduction

Use of data analysis techniques such as Education Data Mining (EDM) [1] with predictive Machine Learning (ML) models in course recommendation and performance monitoring of students helps improve completion rates of students in institutions of learning.

The proactive performance monitoring and interactive intervention model developed by this study - PROACTED enables students self-assess and educators take active measures in monitoring student performance and intervening based on need.

Sentence-BERT (S-BERT)-based recommender model offers a selection of relevant courses to students to pursue based on interests and academic capabilities while the predictive Logistic Regression (LR)-based performance monitoring model provides completion probabilities.

Dataset

The dataset used for model training and testing consisted of approximately 100,000 instances, each representing an individual student's record.

The attributes used included:

- percentage of lessons attended compared to the total number of lessons in the stated period
- aggregate points
- homework submission rate
- activity on online learning platforms
- Continuous Assessment Tests (CATs) marks
- percentage of deadline adherence

These features cover a broad spectrum of academic and behavioral metrics, providing a holistic view of student performance.

PROACTED

The course recommendations from the recommender model are highly relevant and tailored to the students' academic profiles and interests.

The predicted probabilities align well with the study's goal of performance evaluation, showing the probability of a student passing at any point thus enabling targeted interventions.

Methodology

Two models were developed: the course recommender model and the predictive model for performance evaluation. In the recommender model, SBERT [2] was fine-tuned to adapt it to the specific requirements of the recommendation system. Cosine similarity was used to compare sentence embeddings, determining the relevance of courses based on student responses.

Input: Best performed subjects, interests.

Output: The five most recommended courses based on input.

The LR model was trained to predict the likelihood of students completing school based on various academic and engagement metrics. The training process involved fitting the model to the training data by minimizing the Mean Squared Error (MSE) between the predicted and actual values.

Input: Results on continuously monitored academic performance metrics.

Output: Student's probability of passing/finishing the course.

Results

The SBERT-based recommender model, fine-tuned for course recommendations, provided highly relevant and personalized suggestions based on student profiles. The model had an accuracy of 0.94, demonstrating its ability to provide relevant course options based on input.

These course recommendations are able to guiding students towards courses that match their skills and academic capabilities, thus enhancing their academic success and satisfaction.

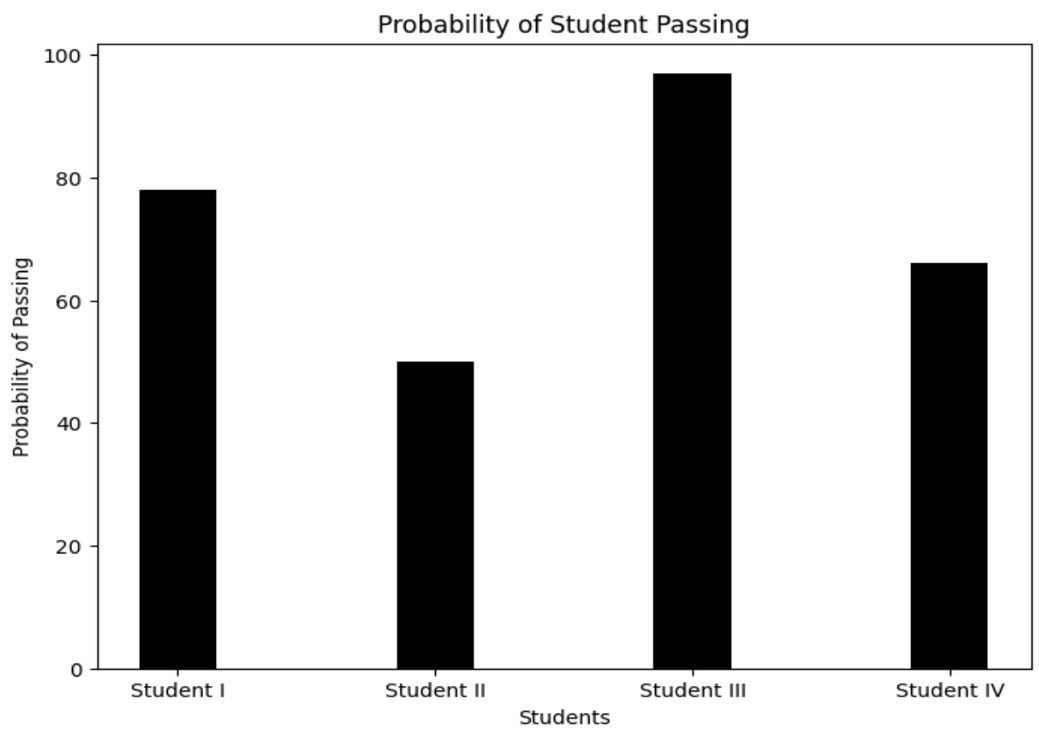
The LR-based predictor model achieved a test accuracy of 0.97, indicating strong predictive power for determining students' likelihood of passing.

Table 1 shows performance. High accuracy and low error metrics demonstrate the model's reliability in predicting student outcomes.

Table 1: Prediction Model Performance

Metrics	Mean Squared Error (MSE)	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)	R-squared (R^2)
Score	0.25	0.50	0.50	0.97

Figure 1 shows sample output of the prediction model.



Future Work

Further work will involve integration with well anonymized, real-world to further enhance model accuracy and relevance. Additionally, implementation of a feedback mechanism where students can rate the relevance of recommendations will enable continuous model improvement based on real user experiences.

References

[1] Sergey Kovalev, Anna Kolodenkova, and Evgenia Muntyan. Educational data mining: current problems and solutions. *In 2020 V International Conference on Information Technologies in Engineering Education (Inforino), pages 1–5. IEEE, 2020.*
[2] Reimers, N., Gurevych, I., 2019. Sentence-bert: Sentence embeddings using siamese bert-networks. *arXiv preprint arXiv:1908.10084.*

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