

**Title:** Predicting Academic Success of College Students Using Machine Learning Techniques

**Authors:** Sahar Helal, Jian Li, Lian Liu, Ehsan Ebrahimie, Shane Dawson, David J. Murray, and Qiang Long

**Published in:** Data, Volume 9, Issue 4, April 2024

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## 1. Introduction

Predicting academic success is a crucial challenge in higher education. With the increasing diversity of students, machine learning (ML) techniques provide an effective means of analyzing complex educational data and identifying key success factors. This study explores multiple ML algorithms to develop a robust predictive framework for academic performance.

## 2. Methodology

### 2.1 Machine Learning Models Used

Several machine learning models were tested to predict student success, including:

- **Random Forest** (Ensemble learning for high accuracy)
- **Support Vector Machine (SVM)** (Effective for classification problems)
- **Gradient Boosting** (Boosting-based approach to enhance predictions)
- **Artificial Neural Networks (ANNs)** (Deep learning model for complex patterns)

### 2.2 Dataset and Features

The dataset included student demographic, behavioral, and academic records, with features such as:

- **Academic records:** GPA, course performance, test scores.
- **Behavioral factors:** Class participation, engagement in online resources.
- **Demographic details:** Age, financial background, previous education.

## 3. Results and Analysis

- **Random Forest and Gradient Boosting** performed best in terms of prediction accuracy.
- **Class participation and online engagement** were among the most influential predictors.
- **Artificial Neural Networks (ANNs)** showed promise but required more data for optimal performance.
- **A personalized academic intervention framework** was proposed to assist at-risk students based on the prediction results.

## 4. Conclusion and Future Work

This study confirms that machine learning techniques can effectively predict student academic success. Future research should focus on integrating real-time learning analytics and adaptive interventions to further enhance predictive accuracy and support personalized learning experiences.

## 5. References

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