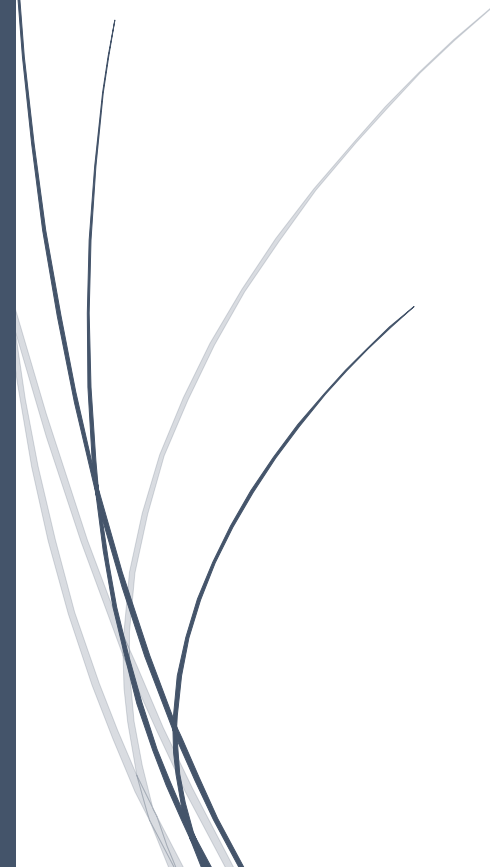


The logo for RADemics, featuring the text "RADemics" in white on a blue arrow-shaped background pointing to the right. The arrow is part of a larger blue horizontal bar that is attached to a dark blue vertical bar on the left side of the slide.

RADemics

Hybrid Artificial Intelligence Models for Academic Performance Prediction in Higher Education

A decorative graphic consisting of several thin, curved lines in shades of blue and grey, originating from the bottom left and extending upwards and to the right, resembling stylized grass or reeds.

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Hybrid Artificial Intelligence Models for Academic Performance Prediction in Higher Education

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Abstract

The rapid integration of Artificial Intelligence (AI) in higher education has revolutionized academic performance prediction, providing data-driven insights that enhance decision-making and student support. This chapter explores the potential and challenges of hybrid AI models in predicting academic outcomes, focusing on the combination of multiple machine learning techniques to achieve superior accuracy and robustness. Hybrid models, which integrate algorithms such as neural networks, decision trees, and ensemble methods, are particularly effective in handling diverse educational datasets, which include demographic, behavioral, and academic performance data. The chapter examines the key methodologies for developing hybrid AI models, including data preprocessing, feature engineering, and algorithm selection, while addressing common challenges such as missing data, class imbalance, and model interpretability. Ethical considerations, such as student consent, data privacy, and bias mitigation, are also discussed, with a focus on ensuring that AI systems in education are transparent, equitable, and aligned with institutional values. By exploring both the theoretical foundations and practical applications, this chapter provides valuable insights into how hybrid AI models can transform academic performance prediction, offering institutions the tools to implement personalized learning experiences and early intervention systems that improve student outcomes.

Keywords: Hybrid AI models, academic performance prediction, machine learning, data privacy, feature engineering, ethical considerations.

Introduction

The growing reliance on Artificial Intelligence (AI) in educational settings has become a defining trend in the modern era [1]. As higher education systems strive to enhance the learning experience and outcomes for students, AI offers a promising solution for predicting academic performance and identifying students at risk of underperforming [2]. Traditional methods of assessing academic success often rely on limited data, such as grades and attendance, which fail to account for the multifaceted nature of student achievement [3]. Hybrid AI models, which combine multiple machine learning algorithms, provide a more nuanced and accurate approach by integrating diverse data sources, such as demographic information, past performance, engagement metrics, and behavioral patterns [4]. These models offer the potential to capture complex

relationships between variables, thereby improving the accuracy of predictions and enabling educational institutions to make more informed decisions [5].

The power of hybrid AI models lies in their ability to combine the strengths of different algorithms, creating a robust predictive system that outperforms individual machine learning techniques [6]. For example, neural networks excel at detecting complex, non-linear relationships within large datasets, while decision trees and ensemble methods offer interpretability and transparency [7]. By integrating these diverse methods, hybrid models can produce more accurate and actionable predictions, helping to forecast academic outcomes such as course grades [8], graduation rates, and the likelihood of student success [9]. These models also allow for the integration of multiple data types, which is essential in higher education, where student success is influenced by a wide array of factors beyond just academic performance [10].

The integration of multiple machine learning algorithms in hybrid models also addresses some of the limitations inherent in traditional prediction methods [11]. In particular, educational data is often incomplete, noisy, and highly dimensional [12]. Handling such data with conventional techniques can lead to inaccurate or biased predictions. Hybrid AI models offer a more effective way of dealing with these challenges by combining different approaches that complement each other [13]. For instance, decision trees can be used to handle categorical variables, while deep learning models are better suited for processing unstructured data such as text or images [14]. This flexibility enables hybrid models to tackle a wider variety of data types, resulting in more comprehensive and reliable predictions [15].