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EXPLAINABLE BEHAVIORAL INTELLIGENCE FRAMEWORK FOR ACADEMIC PERFORMANCE ANALYSIS USING MACHINE LEARNING AND SHAP-BASED INTERPRETABILITY

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The impact of excessive gaming behavior and imbalance in behavioral patterns among students on academic performance and cognitive stability is a major issue. In this paper, an intelligent and explainable behavioral analytics framework is introduced to examine the interdependency among gaming behavior, dynamics of stress, addiction behavior, and academic performance through machine learning and explainable artificial intelligence (XAI) approaches. Several behavioral traits, such as gaming hours, studying hours, sleeping hours, stress value, social interaction hours, attendance percentage, reaction time, and addiction score, were selected for modeling. Four machine learning algorithms, namely logistic regression, random forest, XGBoost, and CatBoost, were utilized for predicting academic performance. Experiments show that the CatBoost algorithm yields better results than the other algorithms, achieving the highest accuracy of 87.43% compared to the XGBoost algorithm, which yields an accuracy of 87.06%. SHAP-based explainability analysis suggests that studying hours, sleeping hours, and stress level are the top three behavioral factors that influence academic performance. Furthermore, t-SNE behavioral clustering analysis, cognitive topology, and addiction-stress density plot were used to visualize the hidden behavioral patterns.