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Machine Learning Approach for Predicting Students' Academic Performance and Study Strategies Based on Their Motivation

Authors : Fidelia A. Orji, Julita Vassileva

Abstract : This research aims to develop machine learning models for students' academic performance and study strategy prediction, which could be generalized to all courses in higher education. Key learning attributes (intrinsic, extrinsic, autonomy, relatedness, competence, and self-esteem) used in building the models are chosen based on prior studies, which revealed that the attributes are essential in students' learning process. Previous studies revealed the individual effects of each of these attributes on students' learning progress. However, few studies have investigated the combined effect of the attributes in predicting student study strategy and academic performance to reduce the dropout rate. To bridge this gap, we used Scikit-learn in python to build five machine learning models (Decision Tree, K-Nearest Neighbour, Random Forest, Linear/Logistic Regression, and Support Vector Machine) for both regression and classification tasks to perform our analysis. The models were trained, evaluated, and tested for accuracy using 924 university dentistry students' data collected by Chilean authors through quantitative research design. A comparative analysis of the models revealed that the tree-based models such as the random forest (with prediction accuracy of 94.9%) and decision tree show the best results compared to the linear, support vector, and k-nearest neighbours. The models built in this research can be used in predicting student performance and study strategy so that appropriate interventions could be implemented to improve student learning progress. Thus, incorporating strategies that could improve diverse student learning attributes in the design of online educational systems may increase the likelihood of students continuing with their learning tasks as required. Moreover, the results show that the attributes could be modelled together and used to adapt/personalize the learning process.

Keywords : classification models, learning strategy, predictive modeling, regression models, student academic performance, student motivation, supervised machine learning
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