

A new explainable and interpretable ML-based framework for educational data mining

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Abstract. During the last two decades, the adoption of machine learning techniques for has gained popularity for addressing many challenging issues in the educational domain. Nevertheless, in the educational field, the interaction between AI systems and humans is a major concern, there is a need of developing new Explainable AI systems, which are able to provide the data analysis results in a human understandable way. In this work, we propose a new explainable framework for predicting students’ performance, which provides accurate, reliable and interpretable predictions. The proposed framework is based on the recently proposed NGBoost algorithm for the development of an efficient prediction model as well as on LIME and SHAP importance methods for providing local and global explainable, respectively. The presented use cases demonstrate the application of our framework and the recommendations, which could be provided to both the educators and the students.

Keywords: Educational data mining, machine learning, recommendation, explainability

1 DATASET₁

This dataset includes information about 337 university students who attended an academic course using a Learning Content Management System (LMS) in a blended learning environment. The dataset were collected from Department of Educational Sciences and Early Childhood Education during the years 2007-2010. Each instance contains information related to the students' perceptions about the Moodle LMS and their opinions about its educational value and usefulness as well as information related to the students' activity. Demographic values were not include due to the similar characteristics of all participants. Finally, the students were classified whether they passed the lesson ("Pass") or not "Fail". More information about this data can be found in [1].

Attribute	Type	Description
Computer_at_home	Nominal	Whether the student owes a computer
Internet_at_home	Nominal	Whether the student has internet connectivity at home
Computer_use_per_week	Ordinal	Frequency of student's weekly computer use
Ease_of_Moodle_use_perceptions	Categorical	Students perception of Moodle usability
Moodle_use_capability_perceptions	Categorical	How capable did the students thought they were, while using Moodle during the semester
Attitude_about_Moodle	Categorical	Students attitudes towards Moodle
Perceived_Moodle_Usefulness	Categorical	Students' perception about the usefulness of the material delivered via Moodle
Perceived_Usefulness_assignment	Categorical	Students' perception about the usefulness of the assignments were given via Moodle
Total_actions	Integer	Total number of actions per student
assignment_view	Integer	Number of actions in the Moodle assignment section
course_view	Integer	How many times the student accessed the description and the basic material of each weekly laboratory session
student_forum_view	Integer	How many times the student accessed the forum section
questionnaire_view	Integer	How many times the student accessed the questionnaire section which contained assessment rubrics referring to educational software

resource_view	Integer	How many times the student accessed the service which contained upplementary material and additional learning resources
user_view	Integer	How many times the student accessed the service which contained each user's overview profile
user_view_all	Integer	How many times the student accessed the service which contained all users' overview profiles
Final_note	Ordinal	"Fail", "Pass"

Table 1. DATASET₁: Attributes description

2 DATASET₂

This dataset 3716 students in courses of "Mathematics" of the first 5 years of secondary school. The data have been collected by the Microsoft showcase school "Avgouleas-Linardatou" during the years 2007 to 2016. Each academic year, teachers are required to utilize a variety of assessment methods. This dataset summarizes information about the students' performance from the first two out of three semesters such as tests grades, final examination grades oral grades as well as semester grades. The students were classified utilizing a four-level classification scheme according to their performance i.e. "Fail", "Good", "Very Good" and "Excellent". More information can be found in [2].

Attribute	Type	Description
Oral_A	Integer	Oral grade of the 1st semester
Test1_A	Real	Grade of the 1st test of the 1st semester
Test2_A	Real	Grade of the 2nd test of the 1st semester
Exam_A	Real	Grade of the final examination of the 1st semester
Semester_Grade_A	Integer	Grade of the 1st semester
Oral_B	Integer	Oral grade of the 2nd semester
Test1_B	Real	Grade of the 1st test of the 2nd semester
Test2_B	Real	Grade of the 2nd test of the 2nd semester
Exam_B	Real	Grade of the final examination of the 2nd semester
Semester_Grade_B	Integer	Grade of the 2nd semester
Grade	Ordinal	"Fail", "Good", "Very Good", "Excellent"

Table 2. DATASET₂: Attributes description

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References

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