

A STUDY ON PREDICTION AND EXPLAINABILITY IN EDUCATIONAL DATA MINING

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Abstract

Predicting students learning performance is very essential for the success of an educational institution. Performance of students is influenced by many factors, so students must be given proper guideline for their success. Early identification of their abilities helps them to give proper training to perform better in their education. Their learning behavior is affected by different demographical problems, so a better explainability method is needed to find the actual reasons that lead to such a prediction is necessary to make remedial action for giving better assistants. This paper focuses on the need for a better algorithm for prediction and explainability in educational data mining.

Keywords - EDM, machine learning; interpretability; explainability;

I INTRODUCTION

The main purpose of this study is to make a detailed review of the literature on the early prediction of educational performance of the student and the interpretation system in order to give the readers an insight of the different technique used for the prediction of student performance and the importance of interpretation system in educational field.

Predicting academic performance is important not only to help students for managing their learning skills and become a self-governing student but also to allow teachers to identify students at risk and chances of failure can be reduced.

The motive of the EDM field is to analyze the data generated by different machine learning algorithms and various techniques of data mining. The main aim is to find the hidden information and patterns that will work to improve learning success of the student

In recent times, machine learning method of interpretation is a major developing field. Many real-world problems require the need of interpretation along with the prediction system and the understanding of how the system reached the final prediction is also an important factor for the users to trust the system and help them to make critical decisions.

Successful predictions of overall performance of the students have a profound impact on many stakeholders, including students, teachers and educational institutions. It is at most important to have an accurate and detailed explanation of the prediction.

This article deals with the prediction and interpretability method in Educational Data Mining.

II IMPORTANCE OF DATA MINING

The other name of data mining is knowledge Discovery in Database (KDD). The main aim of data mining is to obtain the patterns and other valuable information from large data sets. Generating descriptions and predictions of a target data set is the main purpose of data mining technique. Used technologies in data mining techniques are mainly used for automating the prediction system of trends and behaviors for discovering previously unknown pattern to generate business opportunities.

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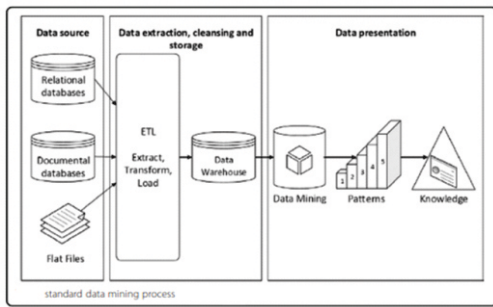


Fig.1 Eyman Alyahyan and Dilek Düşteğör

What is Educational Data Mining?

Educational data mining is a new field. Apply different data mining technique in educational field for various prediction or suggestion purposes then it is called educational data mining. The main objective of educational data mining is to predict student performance.

Data mining technology helps colleges and universities by providing most important information from the data sets which they have collected about the behavior of students and potential learners.

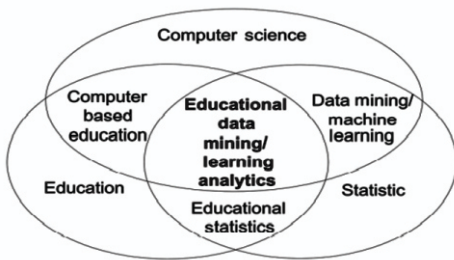


Fig.2 Main area related to Educational Data Mining

Educational data are gathered from different sources such as feedback from student, interaction between teacher and students, administrative data, academic data and demographic data.

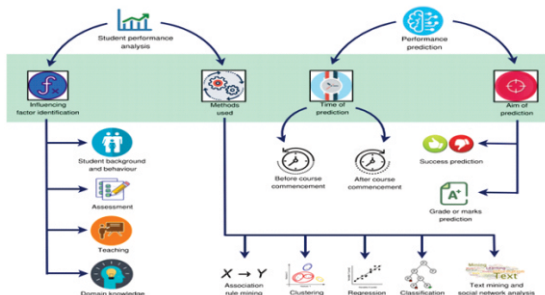


Fig.3 Student Performance Prediction System

III MINING TECHNIQUE

There are two types of techniques for early prediction of student such as supervised learning and unsupervised learning. Supervised learning includes Classification and Regression. Classification is used to predict a categorical or nominal value whereas regression tries to predict a numerical value. Unsupervised learning includes clustering and association. Clustering puts similar objects into groups and association finds associations or relationships.

3.1 Algorithms used in EDM

3.2.1 Classification Algorithms

The most used algorithms are Decision Tree, Random Forest, Support Vector Machine, Naive Bayes, K-Nearest Neighbour, Boosted Tress, Adaptive Boosting and Gradient Boosting.

3.2.2 Regression Algorithms

Popular regression algorithms included Logistic Regression, Linear Regression and Bayesian Additive Regressive Trees.

3.2.3 Clustering Algorithms

Popular clustering algorithms are K-Means, Balanced Iterative Reducing and Clustering using Hierarchies.

3.2.4 Association Algorithms

Most used Association algorithms are Class Association Rule and Random Guess.

A Review made by N D Lynn and A W R Emanue found the following accuracy level of commonly used prediction algorithms (2010–2020).

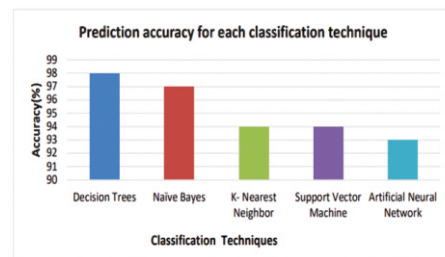


Fig.4 Performance Prediction Accuracy

3.2 Explainable Machine Learning

Interpretability provides a human to understand how the prediction system reached the conclusion. Interpretability gives transparency to the prediction system. Machine learning method provides different methods for the improvement of the prediction system.

Interpretability of a machine learning algorithm refers to how easily a human can understand the processes to arrive at the outcomes. Interpretable machine learning model gives the ability to explain or to present the behavior of a student in understandable terms to humans.

A. Interpretable machine learning categories

- **Intrinsic interpretability** is a self-explanatory model. Self-explanatory models are constructed to achieve the intrinsic interpretability. This category of family includes rule-based model, linear model, decision tree etc.
- **Post-hoc**- In order to provide explanations for an existing model creation a second model is required.
- **Global interpretability model** works globally. Users can understand this globally working model by inspecting the structures and parameters of the model.
- **The local** interpretability model locally tests a **particular** prediction of a model, trying to **understand** why the model **made** the decision it **made**.

B. Explanation Method's Properties

Robnik-Sikonja explained some properties of explanation methods.

- **Expressive power**—the explanation generated by the method has some language or structure which is called expressive power.
- **Translucency**— the explanation method depends upon on looking into the inner workings of the ML model

which represents the translucency, such as the model's parameters.

- **Portability** means the range of ML models which can be used to apply the explanation method.
- **Algorithmic complexity**— complexity of the explanation method is called computational complexity.

C. Interpretable Models

Following are the main interpretable models

- **Linearity** – in this mode, the association between feature values and target values is modeled linearly.
- **Monotonicity** - The increase or decrease in the target outcome may vary when the feature value changes. Monotonicity is helpful for understanding the relationship between target and some features.
- **Interaction** - The ability of some ML language to naturally include interaction between features which help to predict the target outcome.

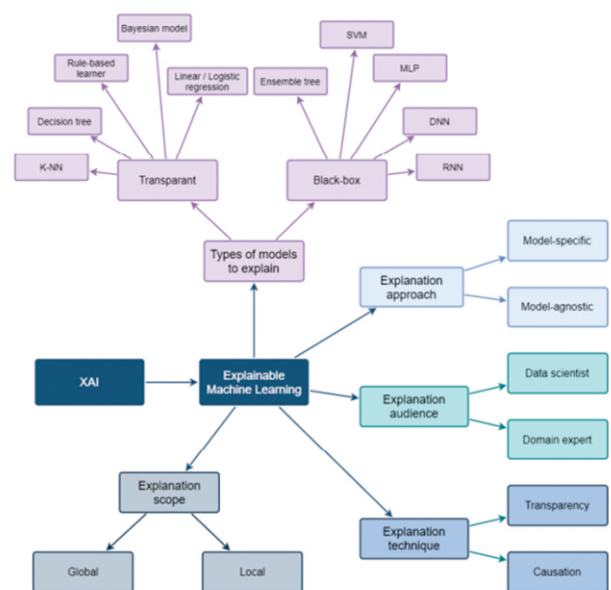


Fig. 5 Taxonomy of explainable machine learning

IV RELATED WORK

In the last few years, many researches have been carried out in the area of EDM and Explainable ML in which various papers and review papers have been published.

- [1] A systematic review of research literature on student prediction method conducted a review of 82 papers. The review paper identified that most of the papers analyzed were about online learning systems and traditional face-to-face learning in secondary and tertiary education; the most commonly used predictive algorithms were J48, Random Forest, SVM, and Naive Bayes (classification), and logistic and linear regression (regression).
- [2] A thesis paper, written by Ouafae el aissaoui, identified four types of computer based educational system: Learning Management Systems (LMS), Massive Open Online Courses, Intelligent Tutoring Systems (ITS), and Adaptive Hypermedia Systems (ONLY THREE HERE). This paper also discussed student modeling and decision support system. Paper identified three models: Analyzing the learners' behaviors, predicting the learner's characteristics and predicting the learners' performance.
- [3] This paper is to give an overview of the EDM technologies used in big data and popularly used algorithms for data mining applications. It also gives suggestion for combining big data mining technology with educational data mining algorithms.
- [4] This paper presented the benefits and applications of data mining techniques in many educational areas.
- [5] A new proposal is made by this paper for prediction based on the performance of the student by including the behavior feature of the students. This paper also proposes an ensemble model such as AdaBoost, Bag and

RUSBoost to increase the accuracy of the model.

- [6] This review paper mainly focused on data mining tools and algorithms mainly used for educational data mining. This review paper gives the necessity of better prediction algorithm and new data mining tools for educational data mining areas which will help the instructor and institution to increase their study level.

V CONCLUSION

The main purpose of this paper is to give an idea about the importance of explainability in education sector. Explainable model is utilized in many domains, but it is not much explored in educational sector. In educational sector, a lot of research methods are conducted for prediction. The prevalent method includes predicting the performance of the students, finding the undesirable behaviors of student and predicting dropout chances. All research papers focused to increase the prediction accuracy, so there is a huge gap between prediction and explainability exists in the educational field. In order to understand student behavior and improve student performance, determine the learning priorities and improve the learning process, the prevailing prediction method is not enough, so a better explainability system is needed.

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