Abstract

From the emergence of the Web onward new learning modes such as distance learning and blended learning have developed. At the same time, *Artificial Intelligence* (AI) has taken hold in most areas including education.

This dissertation focuses on the application of AI (i) to predict the student's exam outcome and (ii) to enrich learning resources.

Student outcome prediction is a topic of great interest in the learning analytics literature. Two methodologies were proposed to address (a) *early* prediction, i.e. make predictions at different time instants from the beginning of the course, and derive (b) *explainable* models, i.e. its output can be explained in a way that "makes sense" to a human being at an acceptable level. The combination of these two characteristics provides insight into why a student is at risk of failure and enables to intervene as soon as possible. The first methodology is based on *Lazy Associative Classifier* L^3; associative algorithms enable the derivation of human-readable rules to explain the prediction reasons and extract student profiles. The second methodology named *VESPE* integrates different machine learning models and allows determining the impact of each variable through *SHapley Additive exPlanations (SHAP)*, a state-of-the-art explainable method based on game theory. Both techniques were validated in two case studies involving university courses. In addition *UNIFORM*, a method for integrating different educational datasets, used by other studies for student outcome prediction, has been proposed.

To *enrich learning resources material*, two AI techniques based on named entity linking were discussed; the first one, called *VISA*, performs *video-lecture indexing* with semantic annotations enabling students to search more easily for specific content, a practice especially beneficial for reviewing before the exams. *VISA* outperformed competing algorithms on a dataset inherent to an undergraduate Database course. The second technique, called *TVREM*, address *video to text and text to video retrieval*

of educational resources: it allows searching for a video from a text and vice-versa to align different resources related to the same topic. *TVREM* was validated with two datasets containing educational vid +s and textual content achieving significantly higher results than baselines and competitors. In addition, an application based on *TVREM* has been proposed to automatically derive educational Youtube videos from textbook paragraphs. The introduction of *VISA* and *TVREM* is beneficial to learning since literature revealed that both video-lecture indexing and cross-media retrieval of educational resources increase student engagement and lead to higher achievement on exams.