**Predict assignment submission using Deep Learning**

During the last decade, an increasing number of studies have been making use of educational data for the identification of factors that affect or predict students’ performance. Until recently the approach of these studies employed traditional methods such as regression or covariance analysis. For example, **Ke and Xie [1]**, applied variations of covariance analysis to quantitative data gathered through surveys to examine the relationship between age and adult students' learning satisfaction, concluding that the evidence suggests there is no correlation.

The availability of data, including datasets that are produced through digital measurements, has recently made possible the use of novel, machine learning approaches for their analysis. For example, **Smith et al [2]**, introduced a deep-learning-based diagrammatic student model, which employs artificial neural networks to analyze student drawings. They predicted student’s understanding and performance. They showed that this model is most accurate and outperforms other competitive baseline diagrammatic student models on both convergence rate and convergence point. **Guo et al [3]**, developed a Deep Learning classification model which automatically learns multiple levels of representation, to predict student performance. Their experimental results showed the effectiveness of the proposed method which can be applied into academic pre-warning mechanism. **Xiong et al [4]**, compared the well-studied Performance Factors Analysis (PFA) and Bayesian Knowledge Tracing (BKT) with the emerging Deep Knowledge Tracing (DKT) algorithm in terms of their power of predicting student performance in 5 different data sets. They discovered that when applied to properly prepared datasets, DKT does not clearly outperform PFA. **Wang et al [5]**, trained a recurrent neural network two tasks of predicting student’s future performance. By training on these tasks, their model exposed patterns about a student’s learning behavior, reliably predicted future student performance, and more interestingly, was able to pick out students who have true knowledge gaps within a pool of poorly performing students.

**Okubo et al [6]**, provided evidence supporting the effectiveness of Recurrent Neural Networks as a method for predicting final grades of students, when compared with multiple regression analysis. Experimental results provided by **Zhao et al [7]**, showed that a drowsy student state detection method integrating a deep convolutional neural network is more efficient and effective than traditional methods. **Qiu et al [8]**, showed that a student dropout prediction model based on two-dimensional convolutional neural networks (DP-CNN) applied on clickstream data of students learning behaviors can achieve better results than the related baseline methods in predicting students’ dropouts in MOOCs.

A deep neural network which is a combination of Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN), was proposed by **Wang, Yu and Miao [9]**, for the solution of dropout prediction problems in MOOCs. The key advantage of their model is that features used in the model are automatically extracted from the raw records. **Chunqiao, Xiaoning, and Qingyou [10]**, showed that a neural network model is a reliable tool to predict student study failure risk. **Fok et al [11]**, focused on how to use Tensorflow artificial intelligence engine for classifying students’ performance and forecasting their future universities degree program. Their results showed that it is not always true that the accuracy of the result increases along with the number of hidden layers of a neural network, but that there is an optimal point.

The potential of machine learning in educational research is also supported by the fact that apart from studies which apply data analysis tools for the derivation of insights concerning students’ performance, other studies aim to develop novel machine learning based tools which can be used in future research. For example, **Ara, Simul, and Islam [12]** integrated and develop a student face recognition system using Convolutional Neural Networks (CNN) to generate a low dimensional representation called embeddings, which are used to classify the person’s facial image. Results showed system accuracy greater than 95%. Their face recognition system could be applied for the development of a student attendance system. In another study, **Sun et al [13]** employed Convolutional Neural Networks (CNN) to detect emotions by analyzing facial expressions of e-learning students.

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