



Machine Learning Applications in Education

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Abstract: *Nowadays, artificial intelligence has become an identity that defines modern technologies and their applications across various fields of industry, especially in the field of Information Technology. Most of the educational institutions have integrated informational technologies in the everyday learning process and employing machine learning can greatly enhance their efficiency. The aim of this paper is to present the application of machine learning in the education area as well as its impact in altering the learning experience.*

Keywords: *artificial intelligence, machine learning; education; adaptive learning; Moodle.*

1. INTRODUCTION

Artificial intelligence is a branch of Computer Science engaged in building intelligent machines or computers capable of performing tasks commonly associated with human beings. In 1569, Arthur Samuel coined the term "machine learning" to describe computational methods that use available data to identify hidden patterns and make intelligent decisions [1]. Nowadays machine learning is being used in a number of areas. Industries like healthcare, banking, energy and retail are rapidly transforming and improving using machine learning technologies. Among them, education industry also has incredible potential for the application of machine learning [2].

There are different ways of using machine learning technology in education. Every student has different learning preferences and machine learning can support personalized learning in a number of ways [3] [4]. Machine learning algorithms, using the data about students' educational background and preferences, can also predict the right career path for each student [5] [6].

There are many countries that have deployed some type of automatic grading system, based on artificial intelligence, from middle school to college level. Automated grading if proven effective does not only reduce the time for scoring, but comparing it with human scores also makes the score realistic [7] [8].

Using intelligent tools for analyzing large amounts of data can provide educational institutions with the insights needed to predict enrollment, improve retention, reduce administration hours, arrange schedules for teachers on a daily basis etc.

This paper is organized as follows. Section 2 presents Machine learning and some of its main techniques. Examples of machine learning applications are also provided. Section 3 discusses the use of machine learning in education and presents some of the most popular platforms which support formal education as well as lifelong learning.

2. MACHINE LEARNING ALGORITHMS

Machine learning uses algorithms to parse data, learn from that data, and then apply what they have learned to make better decisions and predictions [9]. The machine learning algorithm is run on "training data" to build a model which should be a mathematical representation of a real-world process. The process of finding patterns in the training data is called "model training" or "learning process".

Machine learning algorithms are divided into two major groups: supervised algorithms and unsupervised algorithms. For example, if we want to create a model to predict whether a student gets admitted into a university, based on their results on two exams, we would use historical data from previous applicants as a training set. For each training example, we have the applicant's scores on two exams and the admissions decision. The classification model should estimate an applicant's probability of admission based on the scores from those two exams, without being specifically programmed to do so. This type of learning is called supervised learning, because the correct answer is given, in contrast to unsupervised learning where the machines are not fed with the labeled outcomes.

Recent development in sensor networks and communication technologies has enabled the collection of big data and deep learning has played an important role in big data analytic solutions [10]. Deep learning is a class of machine learning algorithms that imitate the workings of the human brain called artificial neural network. Deep learning techniques process data in real-time with high accuracy and efficiency by using a huge set of data and neural network architectures that contain many layers. The term Big Data refers to collection of heterogeneous data formats (text, image, video, graphics and so on) which is generating fast and requires to be processed in real time.

2.1. Examples of machine learning applications

The total amount of data created, captured, copied, and consumed in the world is forecast to increase rapidly, reaching 59 zettabytes in 2020. The rapid development of digitalization contributes to the ever-growing global data sphere and the need for machine learning is increasing day by day [11]. The reason for this is its ability to learn from data and provide data driven insights, decisions, and predictions [12]. The most convenient way to describe the potential of machine learning is to present how it is being used in various industries and professions. Currently, some of the most trending machine learning applications are: image recognition, speech recognition, automatic language translation, traffic prediction, driverless cars, product recommendations, stock market trending, online fraud detection, email spam and malware filtering and medical diagnosis.

Image recognition is used to identify and detect the feature or an object in the digital image. For example, Facebook uses facial recognition technology to automatically tag people in photos. Google assistant, Siri, Cortana, and Alexa are the virtual personal assistants that are using speech recognition technology to follow the voice instructions. Google Translate as automatic language translation tool uses deep learning to find more accurate words and automatically adjusts to a more natural sentences syntactically that are smoother and more readable [13]. While Google Maps traffic prediction improves its performance by taking information from the user, self-driving cars are trained to detect people and object while driving using unsupervised machine learning. Websites like Netflix, Amazon and Google use recommendation systems to improve customers' online experience by offering products based on their searching activity, past purchases, items liked or added to cart, brand preferences etc. Machine learning algorithms can predict how the stock market will perform with a high degree of accuracy even if there is a great influence of external entities (social, political, economic and psychological) on stock trends. Nowadays cybersecurity is very

important and machine learning can help tracking money frauds online. PayPal is already using machine learning algorithms to distinguish between legitimate or illegitimate transactions between customers and sellers as a measure of protection against money laundering. One more way machine learning has improved cybersecurity is through spam and malware detection. Since machine learning has the capacity to adapt to varying conditions, spam filters constantly generate new rules based on what they have learned as they continue in their spam filtering operation. The machine learning model used by Google has now advanced to the point that it can detect and filter out spam and phishing emails with about 99.9 percent accuracy [14].

Machine learning can facilitate and enhance the work of medical experts by helping them diagnose patients faster and more accurately. It is being used for the analysis of patient's data for disease detection, therapy planning, prediction of the disease progression, medical-related researches etc.

3. MACHINE LEARNING APPLICATION IN EDUCATION AREA AND EXISTING PLATFORMS

Currently, machine learning technology is everywhere, including the education sector, where it has shown great perspective. Adaptive learning is one of the best usages that machine learning provides. Machine learning algorithms can learn how the students consume information based on the amount of time spent on completing each task, response latency and assessment results. This data can be used to tailor courses around the needs of individual students. Many recent Intelligent Tutoring Systems are using machine learning to decide what learning content to provide to a learner. For example, the iTalk2Learn system, designed to help young students learn about fractions, integrates structured, practice-based tasks with exploratory, conceptually-oriented tasks, and affect-aware intelligent support. The system focuses on natural interaction via intuitive user interfaces, which include speech recognition, and speech production [15]. Some of the popular adaptive learning systems are: DreamBox, ALEKS, Reasoning Mind, Querium, Kidaptive and Knewton. NewClassrooms, Carnegie Learning and Thinkster Math are math learning platforms that personalize the students' learning experience by tracking their learning habits and progress, identifying knowledge gaps and offering adequate learning material. Feedback is usually embedded in the instructional process as teachers can monitor overtime performance so that students can get real-time results and suggestions. Khan Academy offers interactive questions, quizzes instructional videos and articles on a range of academic subjects. They

use machine learning to award proficiency and motivate students to move forward in a purposeful way.

Machine learning techniques can be used to evaluate responses in open-response and assessment learning system. Such assessments typically contain questions that require written responses. For each specific question, responses from different test-takers are used to build models that can predict the quality of new, unseen responses [16]. Platforms like WriteToLearn and Turnitin are implementing machine learning to grade essays and detect plagiarism. They also help students develop writing skills and reading comprehension.

Combinations of machine learning algorithms can also be used for recommendation of courses in e-learning systems. Usually, course recommendation systems based on machine learning extract knowledge from learning management systems (LMS) such as Moodle and can be embedded in Massively Open Online Courses (MOOC) to enhance the learner experience [17]. Moodle stores detail logs of all students' activity on the platform. Those logs can also be used for predicting student academic motivation, identify at risk students and increasing students' retention [18]. The framework for a course recommendation system is shown in the Fig. 1.

Moodle has been used worldwide for practical teaching in higher education [19], with the aim to stimulate student independent work through self-evaluation exercises. Applying machine learning to data from activity logs can predict students' performance on the final exam of such courses [20].

Machine learning as a predictive data analytics tool has a potential to discover, analyze and predict meaningful knowledge from educational data which will help to education management system for

flexible planning, execution and prediction for the future [21]. Using prediction models based on truancy, the disciplinary problems, on-course performance (time online, the number of assessments completed, time spent on the assessments) and overall grades the software could identify the most engaged students as well as the struggling ones. Software like eAdvisor and Degree Compass are already used in the United States for those purposes [22].

4. CONCLUSION

The aim of this paper is to point out the importance of machine learning and its application in different areas. The paper also describes the ways machine learning has been applied to the education sector. Existing education-related platforms that use a machine learning component are also presented.

Learning models based on machine learning can help identify individual student needs and sharpen the content delivered to every learner. This will improve student motivation and hence the overall results. Educators will also get a better understanding of each student's learning process, by taking real-time feedback. Machine learning technology can support teachers and institution staff by completing repetitive tasks and routines. Thus, the teachers will have more time to focus on educating their students or engaging in research pursuits. Machine learning algorithms will also enable more efficient enrollment and admissions processes.

Although machine learning offers possibilities for improving the education around the world, we are still in the early stages of its use. A major challenge in the implementation of machine learning system is the big data that would be needed in order to train it. The challenge is finding a way to implement it and to do so in a cost-effective way.

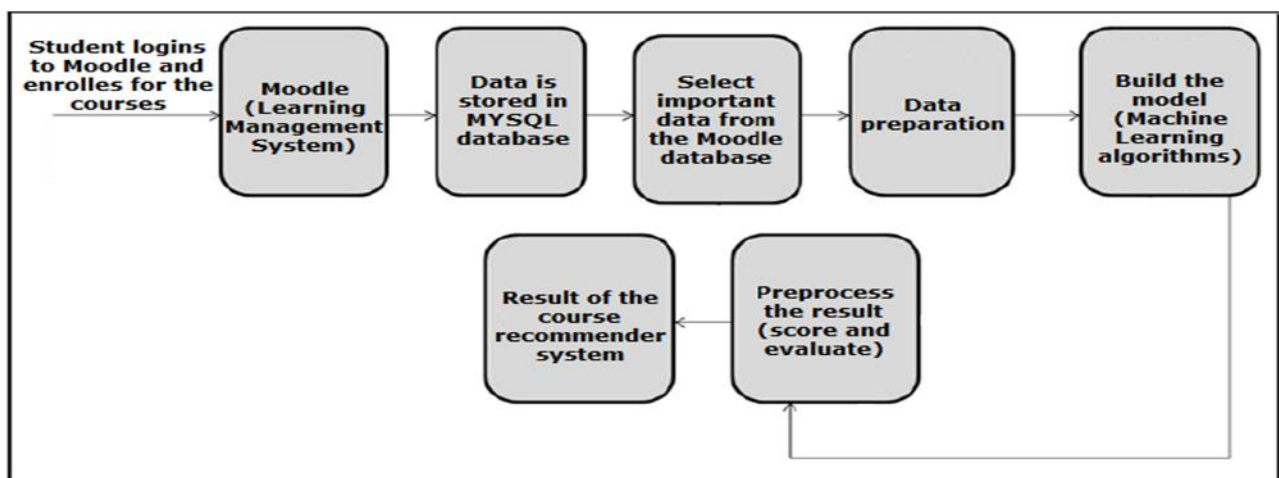


Figure 1. An example of course recommendation system in e-learning

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