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Machine Learning in Educational Technology

Ibtehal Talal Nafea

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Abstract

Machine learning is a subset of artificial intelligence (AI) that helps computers or teaching machines learn from all previous data and make intelligent decisions. The machine-learning framework entails capturing and maintaining a rich set of information and transforming it into a structured knowledge base for different uses in various fields. In the field of education, teachers can save time in their non-classroom activities by adopting machine learning. For example, teachers can use virtual assistants who work remotely from the home for their students. This kind of assistance helps to enhance students' learning experience and can improve progression and student achievement. Machine learning fosters personalized learning in the context of disseminating education. Advances in AI are enabling teachers to gain a better understanding of how their students are progressing with learning. This enables teachers to create customized curriculum that suits the specific needs of the learners. When employed in the context of education, AI can foster intelligence moderation. It is through this platform that the analysis of data by human tutors and moderators is made possible.

Keywords: machine learning, artificial intelligence education, virtual assistant education sector

1. Introduction

Currently, technology is everywhere including the education sector, where it has proven to be of great importance for realizing the learning outcomes for students. Education is no longer just the teaching of text or requiring the student to memorize manuscripts. The instructional process, both inside and outside of the classroom, has become an activity with measurable goals and results. Over time, educational techniques have turned out to be a dynamic part of the inputs and outputs of the learning process. Moreover, these practices have grown into a vital part that plays a significant role in broadening the advancement of the components of the learning system, upgrading the rudiments of the curriculum, and making both more effective and resourceful.

These components are used in the process of planning, implementing, evaluating, following-up and developing objectives [1]. Machine learning has become a new frontier for higher education. Being one of the strongest newer technologies, machine learning plays the main rules in artificial intelligent and human interaction. Machine learning is the innovative tool being used to combat cancer, climate change, and even terrorism [2]. It is the new infrastructure for everything. Consequently, machine learning helps computers to find hidden insights without being programmed to do so. Moreover, machine learning works as a good predictive.

- In this chapter, machine learning technology is used as a principle of educational activities. There are different ways of using machine learning technology in education, such as in providing diverse learning options so a learner can discover what suits him/her best but in a manner where all individual variances between pupils are considered. Machine learning can also be used in review a lesson that was hard to understand [1]. Machine learning in education works in harmony with students' needs, and at a time and place that suits them best.

- Virtual assistance plays a crucial role in education and is a good forum for machine learning use. A virtual assistant can interact in a conversation with students [1]. This interaction involves conversational agents who assist students by using an application or website. The process works is quite simple with the student needing to input text. On the other hand, the agents execute the task and determine the appropriate response to the input before providing an easy response that the student can easily understand.

- Both machine learning and virtual assistants are used to interpret patterns and human interaction which supports deeper learning and provides users with fast and accurate data. This chapter proposes a new education framework that is powered by virtual assistance. It provides customized research for students. The suggested framework allows teachers to monitor their students' progress through their learning activities at any time. This is the best approach to training students to enhance their experience. The framework also helps teachers save time that is normally spent in preparing lectures, creating exams, document review, document creation, and light specific research. The proposed framework facilitates the leveraging of the most powerful technologies in improving the quality of education for both student and teacher. Another advantage associated with this framework of machine learning and virtual assistants is that it is less prone to the errors that usually encumber human operations. If an error occurs, the framework allows it to easily troubleshoot the problem and craft the appropriate resolution of the error.

2. Related works

With the recent increase in the spread and use of technology across the world, it has become common for various sectors to adapt technology for use in their respective fields. This applies the education sector as it does to any other field. Terms such as artificial intelligence (AI), deep learning, and machine learning are now commonly used in education and by education professionals. Indeed, in the educational field, AI is used in machine learning. That is, machine learning makes use of AI in its effort to teach machines how to look for different types of data.

2.1. Machine learning

Currently, education and learning remains largely focused on feeding students with information and hoping that it is retained. Accordingly, a student's intelligence is assessed by testing their ability to recall information previously taught. The problem is that this model ignores examining how well the students understand the information and how they apply it in real-life situations. This model has proven to be toxic over the years. More schools and education centers have begun to realize how use of machine learning can make work more efficient and easier and have started to adopt technology at an increasing rate. Indeed, machine learning can accommodate all kinds of students. In the long run, machine learning is bound to produce the following advantages:

Customized and personalized learning – Machine learning is flexible enough to cater to all students regardless of their learning speeds. By making use of algorithms that learn how the student consumes information, machine learning allows the learner to move ahead only after they have truly grasped the previous content. This process ensures that no student is overlooked or left behind. This is true even if they are the only one in class that has not yet understood the content. The machine learning system also allows teachers to individually monitor student and help them those areas where they are deficient. This contrasts with the traditional educational method, which focuses on a one-size-fits-all management where everyone in class is taught the same way. This type of learning can be found in the EdTech and MagicBox learning systems [3].

Analytics of content—Refers to a machine learning system where teachers instruct students by using machines. The machines are used to analyze the information teachers are using to teach and to determine whether the quality of the content meets the applicable standards. The machines are also used to help determine if the content taught to the students complies with the intellectual ability of each student. Since students are taught in accordance to their individual needs, their learning progress and understanding improve.

Grading—Machine learning systems are used to reduce the amount of time needed to grade student work. In addition, machines are used to increase the efficiency and accountability of the grading system. The system still allows for the larger portion of the grading to be performed by teachers. However, machines aid in the analysis of student information such as in the detection of plagiarism or cheating.

Simplification of tedious tasks—In the traditional method of learning, teachers spend a substantial amount of time in repetitive and tedious tasks, such as taking class attendance or gathering of class assignments. Machines can be used to automate these tasks and reduce the time or need for teachers to do them. Accordingly, teachers will have more time to focus on more important tasks such as making sure that their students fully understand the learning material.

Students' progress—By using machines, the teachers can monitor each student on a personal level and evaluate their learning progress, individually. Machines can also provide additional learning patterns of the students, which help teachers to determine the best ways of teaching the students.

As the above information makes clear, using machine learning in teaching brings numerous advantages to the table. It is therefore advisable for every school to adopt these types of learning platforms, such as the EdTech revolution program. With this, learning becomes easier, more

efficient and customizable to each student's need [4]. By employing methods relating to digital learning, there is the possibility of collecting a wide range of data about the behaviour of the learner, especially in the learning activities. The measurements collected consist of variables like completion time, video views, group discussion activities and test results. Measurements of this nature are applicable in the context of feature engineering that leans on the machine learning algorithms. Experts argue that the algorithms can find a correlation between the specific behaviour exhibited by learners, regarding their learning performance [5]. It is this outcome that is used to determine the overall efficiency manifested by a particular machine program.

Recommender systems are the more obvious target of machine learning usage. The experience of this technology is illustrated by its use on some of the more prominent software platforms like Amazon and LinkedIn. Recently, Twitter has begun applying this technology to their platform. Researchers in the education sector consider recommender systems as the most utilized systems in modern times. In the context of human learning, recommender systems that are oriented to learning in a specific way have the capacity to assist learners properly identify the appropriate content [6]. In this regard, there is a guarantee of realizing the projected competence development objectives as far as machine-oriented education is concerned.

The advance in AI technology has allowed machine learning in education gain a considerable amount of support. In fact, machine learning should be credited for making AI a possible and fruitful endeavor in education. In achieving this result, machine learning has combined and utilized the aspects of mathematical algorithms. Researchers in the vast education field have tried to introduce the concept of machine learning into the mainstream schooling system. The goal has been to use machine learning as teaching assistants that can ease the job of human educators [7]. This approach aids in data provision of the students' performance, coupled with suggested actions geared towards making improvements to the student's learning experience.

The use of machine learning in tools related to education technology has been more significant in its overall applications. Experts have created a real-time platform capable of giving immediate feedback to learners. The same platform has harnessed the efficiency and effectiveness of online-based tutors. In fact, the platform has been credited with almost all the success that takes place on the Internet. The latest platforms are so sophisticated that they are capable of detecting and monitoring the reaction of the student concerning the concepts being taught. This approach is known to reduce the misunderstanding normally experienced during the learning process. The ability of these platforms to give early warning to tutors enables them to avoid mistakes that would have otherwise been made during the learning process [8]. Tutoring systems based on AI is an interesting and resourceful concept, to the extent that it employs substantial amounts of data that is coupled to machine learning, to offer guidance that is personalized and supplemental to the students. The feedback system provided by the AI tutoring systems is critical in tracking the learners' progress.

The adoption of machine learning technology has enhanced the concept of crowd-sourced tutoring. The goal of crowd-sourced tutoring is to provide assistance from private tutors, and in some cases, classmates who fill gaps in understanding by supplementing the content learned in class. Students using social networking sites for learning purposes, like Brainy, are enjoying the effectiveness of AI in the learning process. Most of the social networking sites

that are education-oriented tend to employ AI algorithms which harness their networking features. The algorithms also bring a personal touch to the learning process, making it more appealing to the learner. In addition, AI increases the level of interactivity in these platforms, which is helpful in fostering the learning process.

Machine learning algorithm works by having machines use software applications that assist the machine to determine outcomes that are accurate. By using algorithms, the machines can receive data, analyze it and then produce an output that is within an acceptable range. Machine learning algorithms are divided into two major groups: supervised algorithms and unsupervised algorithms. For supervised algorithms, people input information together with the required results into the machine. With this, the machine can learn what is desired of it when a similar command is inputted. For unsupervised learning, the machines are not fed with the outcome that one would like [9].

In the education sector, machine learning algorithms have made normal operations easier, faster and more efficient when compared to when they are done manually. This has proven to be a game changer in education sector. One of the major benefits of its adoption has been to help identify each student's needs so that the teachers can differentiate between problems general to the class and those specific to individual students. Accordingly, through machine learning, no student is overlooked or left behind. Additionally, with machine learning, students are also given a platform from which they can voice their grievances so that the problems do not escalate beyond resolution. The machines help in the grading, by monitoring the scores of the students in their assignments and the tests. The machines also assist teachers by organizing the information being taught to students. The inclusion of machine learning in education has, therefore, made the education system more convenient for both teachers and students alike.

AI has enabled teachers and to a larger extension, schools, design textbooks and learning exercises that can achieve a high degree of customization to the needs of the user. Content Technologies, Inc. (CTI) is one of the major players in the industry. CTI tends to specialize on deep learning concepts to create custom textbooks [9]. This is achieved by inputting a syllabus into the engine of CTI. After that, the system absorbs the content to generate new patterns. It is then the work of algorithms to use the knowledge gained for the purposes of creating textbook materials.

3. The architecture of the virtual assistance framework

Since students have different styles of learning, it is necessary to use a variety of assistance to help increase the performance level of learning. Various machine learning algorithms and techniques, such as decision-making algorithms and techniques, can be implemented for allowing the virtual assistant to communicate with the students and teachers.

There are two main parts to the virtual assistants, namely, one for students and other for teachers. Students can answer one or more virtual assistant's questions. One or more sponsored links, related to the determined course, is then provided to the student. The sponsored links can be voice, audio data, displaying video or textual information. Exam training and test dates remainder are kinds of the virtual assistant that gets provided to learners. Also, the

proposed system helps students to manage their teamwork project. After the session with the system, a student is provided with the feedback about his progress.

The system is also able to design presentations for specific learners. Notably, different students have different learning abilities; therefore, the system is able to compute a favorable learning style for each student. The teacher monitors the progress of each student through feedback about how each student performed in the sessions. This facilitates appropriate grading. Also, the virtual assistant is able to point out areas of the course that need to be explored further to enhance learning by providing additional reference materials to a topic. Also, the teacher is able to identify which students need extra help using the feedback provided by the system.

The proposed architecture is a reliable virtual assistant website that not only helps teachers and students to do their tasks in a shorter time but also allows them to coordinate their work.

4. Technical implementation

The underlying technical implementation of the virtual assistant system starts with creating use cases for the product. The identification of virtual assistants and the underlying technology are required for moving ahead with the implementation of the proposed website [10]. The following technical specifications have been identified for building the virtual assistant website:

Software used:

- BitVoicer: Speech recognition.

- Python 2.7: Coding language

- Eclipse, Geany or your preferred interface for coding on Python Virtual COM Port.

To facilitate interaction between the virtual assistant website and the user, a software known as Wit.ai is installed. Wit.ai offers a perfect combination of voice recognition, and subsequent machine learning in the context of developers. The software offers services that concentrate on converting verbal commands into text. Moreover, Wit.ai has the capability of understanding the commands that are said. The most sophisticated forms of Wit.ai can be programmed to understand commands whose prior understanding was scant or non-existent. This is crucial in the educational context since learners tend to understand at varying paces. The extensive capability of Wit.ai software to improve the interactivity of virtual assistant website can be verified by the fact that it has been incorporated by a number of notable social media networks, such as Facebook [10].

Clarifai is another service that can be added to the virtual assistant website to improve its interactivity. Clarifai is a service geared towards AI, and it possesses the ability to decode contents that is in an image and video format. Another strength associated with Clarifai is that it possesses a deep learning engine that improves with its usage [10]. The tool is of paramount importance when there is a need to make improvements in the AI prototype and grant it the capability of seeing and recognizing objects.

The virtual assistant experience with the users has been remarkable. All students who provided feedback regarding their interactions reported positive experiences. Fundamentally, the issue of the ease of interactivity, friendly user interfaces and responsiveness were reviewed. The first student reported that the system has a friendly user interface that is not complex, thus allowing a user to navigate through different sections of the system. The student added that the system was highly responsive in terms of answering questions. He recounted that, in the traditional class setting, he was afraid to ask questions in front of the other student. However, the virtual assistant offered personalized interaction where he could ask any questions, clarifications and point out his areas of weakness. The second student who experimented with the software also found it quite useful. He emphasized that he liked the fact that he was able to get immediate feedback on his questions. This was a vast improvement over the traditional way of waiting to talk to the teacher after class, when the teachable moment has already expired. Some instructors are always in a rush after finishing their classes. As such, they are unable to allocate ample time to explain specific concepts taught in class to the student. Therefore, the student misses out on these concepts that might cause low academic performance. In other cases, teachers recommend students with clarifications to get the assistance of their classmates. This hampers full understanding as one needs to develop a rapport with their fellow student to enhance learning, and others become intimidated. However, the virtual assistant allocates enough time and is able to answer all questions, providing detailed explanations. The third student said that she found it was an effective supplement to one teacher's extensive use of multiple choice exams. According to the student, while such exams might tell her whether or not she knows the answer to a question, they do not help her understand the logic underlying the answer. The virtual assistance was helpful in achieving that understanding. The fourth student also reported satisfaction with the system. Firstly, the student confessed to being a slow learner. This had really affected how she grasped concepts. Most of the times, she felt left behind in classwork and had no one to consult as she was shy about her condition. However, the system helped her to learn at her pace and recommended interactive learning model that allowed her ask for clarification after every 10 minutes of the learning session. She was enthusiastic to note that this has helped her understand most of the concepts taught in class and generally improve her grades. Lastly, a teacher who had made use of the assistance said it allowed her more time to figure out what her students actually understood and where they were having difficulties. By so doing, it helped her know which areas needed much attention to enhance understanding. She recounted that teaching a class of 30 students can sometimes be difficult to know who understood well, who needed extra attention on a specific topic and what learning model suited a specific group of students. The virtual assistant, according to the teacher, answers these questions. The system is able to compile interactive activities to address specific learning outcomes to indent whether the students understood the topic.

5. Conclusion

Machine learning with AI has opened incredible possibilities in various fields. This is especially the case in terms of the education sector and education-related fields. This means that future learning environments are likely to be highly personalized, with the ability to help

learners realize their utmost potential in the most fulfilling way. There will be a steady adoption of machine learning in various areas of concern for educational technology. In the initial stages, its impact will not be clearly apparent or significant to the end user. Despite this, teachers have started to see how tasks can be simplified and more effectively completed through the employment and application of machine learning technologies. The advances made in adopting machine learning into education sector have significantly saved teachers' time in both the classroom and non-classroom-related activities. Stakeholders have welcomed this unprecedented benefit, as it makes learning easier and more appealing.

The future work on machine learning, especially in the education context, shall witness the development of more sophisticated AI tools. There are multiple prospects for designing complex chatbots that will improve the sophistication of virtual assistants. This development shall foster more human interactions that will replace emails and text messages. Already, plans are underway for developing online virtual assistants named "Amy" or "Andrew" at x.ai to schedule meetings with both tutors and learners. AI coupled with machine learning that incorporates deep learning and natural language processing is projected to go a level higher by incorporating more sophisticated systems laced with capabilities to adapt, learn and predict systems with utmost autonomy. The future works on these systems shall incorporate a combination of advanced algorithms and embedded massive data sets.

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