

# APPLICATIONS OF MACHINE LEARNING IN EDUCATION AND HEALTH SECTOR: AN EMPIRICAL STUDY

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## ABSTRACT

In today's world machine learning has been incorporated in almost every system/application/algorithm whether it is a hospital management system or a learning management system. This paper lays emphasis on the role of machine learning in everyday life, understanding the many ways of selecting the right technique of ML for your system/application and discussing the various social networking applications that make use of machine learning in their back-end algorithm. The purpose of this research paper is to understand machine learning alongside its usage in the fields of education and health.

**Keywords:** machine learning; health sector; education; empirical study; algorithms;



## 1. INTRODUCTION

Shortly defined as ML, it is the subgroup of artificial intelligence that trains a machine how to learn. It is the field of study that gives the computer the ability to automatically learn without being explicitly programmed [1]. The program developed through machine learning concentrates on accessing the data and using it for learning, identifying patterns and making decisions without human interference [2]. Almost all aspects of our life have been affected by machine learning in some way. Many people are familiar with machine learning through shopping websites such as Amazon. They (Amazon) use recommendation engine to show customer more things according to the previous purchases [31].

When anyone books a taxi through Uber/Careem, he/she will get the details of everything including distance from the current location, expected arrival time, the cars information, the driver's information etc. The application is providing such information to the user through machine learning. The news feed of Facebook also uses machine learning algorithms to personalize everyone's newsfeed. When a user frequently likes photos and posts of a particular friend, the newsfeed will show user more posts from that friend. For this Facebook uses simple predictive analytics and statistical analysis for the identification of pattern in user's data and uses those patterns to adjust the newsfeed.

More examples of machine learning include speech recognition, medical diagnosis, learning association, DNA sequencing, search engine algorithms and financial analysis [3] [15] [40]. Machine learning is occupied by almost every industry including education and health sector. Earlier education was the teaching of text and requiring the student to memorize the books. Today educators are open to try new technology in the education field and they are investing on digital resources for the classrooms. As viewed, integration of technology makes learning and teaching efficient on both ends. The academic world has become more convenient and personalized due to the numerous applications of machine learning. This is changing the procedure of learning as educational material is accessible through smart devices. In today's world, a student doesn't need to attend a class physically as long as they have a computer with an internet connection. Through machine learning institutes are automating their administrating tasks and minimizing the time required to complete challenging tasks. Machine learning has power to support many aspects of education related to both teaching and learning [4] [5].

In health sector, machine learning is playing a significant role in development of new medical procedures, the handling of patient record and the treatment of chronic diseases. Today machine learning is helping in the updating of administrative procedures in hospitals, detects and treats infective diseases and personalized medical treatments. Many companies develop sensors, applications and wearable devices that use data to monitor patient's health in real time [22] [23]. Despite warning from the doctors, the progress keeps increasing. There are many

applications of machine learning in education and health sector for teacher/ student and patient/doctor. In the next section some popular applications with examples are being explained.

## 2. LITERATURE REVIEW

In today's world the use of machine learning is becoming common day by day. One of the leading countries in the fastest development in AI/ML is Japan, with their futuristic technology comprising of human like robots, intelligent vending machines even and having AI be a part of every solution to a problem that may require more human interaction. Machine learning has two main branches which are as follows:

- Supervised Learning
- Unsupervised Learning

In supervised learning the machine or system that you are trying to train is given certain instructions which that system uses to educate itself hence resulting in learning from a set of instructions and gaining experience through some help [32] [33] [34]. Whereas unsupervised learning is completely opposite to supervised. In unsupervised learning the machine or system is not given any instructions or doesn't have any already programmed in manual, instead the machine has to pick up experience and has to educate itself by taking steps on its own. Hence resulting in learning based on mistakes and experience gained. Machine learning can also be used in making predictions [27] [37] [38] [35].

Moving towards our main focused fields which are education and health, machine learning even in these sectors is not behind. For example in the medical sector, the intelligent applications/systems are flexible meaning they can be based on experience or even set of instructions, this however can be acquired by using various machine learning techniques which might be able to give us an output in the form of a systematic description of the many medical features present within the system or application. Such information regarding ML can be displayed in the form of decision trees or ordinary rules. Cardio (used to interpret ECGs) is an example of such a scenario [28] [29] [30]. Similarly, in the education sector there are various tools and applications such as test preparation tools, search engines or even Google scholar. All these tools and applications have some sort of machine learning algorithms/workings being executed at the back end to make the experience for the user more accurate and helpful. For example, when a student searches for a specific paper or problem online, the user expects that the result should be completely relevant. Therefore, to make this happen machine learning, web crawlers and many other technologies come in and play their role to provide the best possible solutions.

## 3. MACHINE LEARNING IN EDUCATION

Currently our education system focuses on delivering students various information. The intelligence of a student is examined by his/her capacity to recall or memorize the information previously taught. The main problem of this approach is that it ignores inspecting about how well the student understands the information and how a student can apply this concept in his/her life. Over past few years this model has proven to be inconvenient or not right. Education is changing with time and over past few years this model has proven pathetic [5]. In addition, there are many other problems that emerge from administration, academic staff and students [6]. In recent years machine learning and other technologies have been applied in the education sector for the solution of the above-mentioned problem. Today's education does not follow a traditional way of educating and it has measurable goals with results. More institutes are adopting applications of machine learning to make their work more efficient and faster.

Teachers use machine learning to reduce their work load by automating different tasks. A common example of machine learning used by a teacher is Turn-it-in for grading and detecting plagiarism. This software simply applies some machine learning algorithm and shows result of copied content in the document. For the help of student there are many online learning websites such as Udacity that applies machine learning algorithms for targeting courses for students. As machine learning is relatively new in the field of education regardless it is used for personalized learning, for prediction of academic results and for many other purposes [7] [39]. There are some applications of machine learning both for students and teachers/institutions according to the research papers available on Research Gate, IEEE and Google Scholar. Mentioned below are the applications of machine learning divided into two sections for the ease of understanding.

## 4. MACHINE LEARNING APPLICATIONS FOR TEACHING

Adoption of machine learning makes teaching more efficient and customizable to student needs. Routine tasks and communication with students can also be managed by machine learning. Choosing a machine learning algorithm for any particular task is difficult as several questions have to be considered such as amount of information, data types and quantity of data attributes. Some applications of machine learning algorithms in teaching are described below:

- **In Gifted Education:** Some students need additional support for their education and sometimes it is difficult to identify these types of students. Machine learning can do it using classification algorithms. Machine learning has potential to make advances in the field of gifted education [8].
- **Predictive Analytics:** Predictive Analytics is a new tool of machine learning that assists both the teacher and the institution to review the performance of the student in-terms of doing prediction about his/her academic result. It is used for identifying students who are at risk of failure in online courses using support vector machine [8]. The placement predictive system uses score of students at different study levels and predicts the chances of placement of student in upcoming recruitment events. Neural network, linear regression, decision tree, Bayesian network-based prediction models are used to predict academic performance of students from different programs at different levels [9].
- **Learning Style:** Every student has a different learning style and they prefer to use different types of resources for learning. A website named as “first aid for you” uses Naïve Bayes algorithm to determine the learning style of the student [10] [9].
- **Grading:** Assessment and evaluation of thousands of papers is not an easy task for any teacher but thanks to the software based on machine learning for making this hectic task easier. Now teachers are using software’s like Grade-Scope and Turn-it-in for the evaluation and grading of their courses [5].
- **Administrative Task Automation:** Several administration tasks such as admissions have been automated by using machine learning and AI. Organizations are using machine learning algorithms to extract data of students according to their admission criteria [11].

## 5. MACHINE LEARNING APPLICATIONS FOR LEARNING

The advances in Artificial intelligence supported the use of machine learning in education. The use of machine learning in the tools of learning became more important and engineers developed platforms that provide real time feedback to the students. Some applications of machine learning for students are mentioned below.

- **Online Learning:** Now learning is not limited to textbooks and classrooms only. There are many digital platforms like udacity, udemy and Edx, Coursera providing short courses and nano degree programs online in different fields. They are using machine learning algorithms for targeting audience and for improving their services [5].
- **Test Preparation tools:** Many test preparation applications and websites available on the internet like Quizlet and Kaplan utilize machine learning algorithms for the better learning of student.
- **Guidance:** Popular employment and talent platform LinkedIn uses machine learning algorithm to match available job with likely candidates.
- **Search Engine:** Google chrome is using machine learning algorithms to provide better search results to the users. Search engine detect pattern is based on your latest searching queries and shows results to you according to it. IEEE and Google scholar are also using machine learning algorithms to find specific articles and papers according to the keyword entered by the user [6].
- **Personalized Learning:** Machine learning algorithms are able to learn about the student’s ability in-terms of grasping information. These algorithms allow students to move forward only when the student completely grasps the previous knowledge. This procedure makes sure that not even a single student is left behind in learning. Edtec and Magic box learning systems are using this personalized learning approach [5] [7].

## 6. MACHINE LEARNING IN HEALTH CARE

Every year many patients die due to the error in health care technology and this problem is not limited to rare conditions only. Cardiac chest pain, tuberculosis, dysentery, and complications of childbirth are commonly not detected in developing countries, even when there is adequate access to doctors [12]. Medical education needs to involve more intelligence and information tools such as robotics and machine learning. Data collected during routine check-up can be used to predict about the conditions that can happen later using machine learning [12]. The applications of machine learning in medical field have been expanding since the last few years. Currently ML is providing many tools and techniques that can help in the diagnostic problems in numerous medical fields. Decision tree and nested analytical structure can help the physician in extraction of minimum data necessary to make a diagnosis [13]. For example, a feature selection algorithm can reduce the number of items necessary in diagnosing an ASD (Autism Spectrum Disorder) with 100% accuracy between 612 patients of ASD [14]. Within past few years, scientists have performed several researches on the diagnosis and cure of cancer. They applied

different methods for finding the type of cancer, its causes and possible symptoms. In imaging, image recognition algorithms have discovered new features of cancer important for diagnosis [14].

ANN and DTS are the major techniques of machine learning used for the detection of cancer since nearly three decades [15]. All this is contributing prominently in the knowledge of pathology. With global usage of smart phones and wearable devices uploading huge amount of personal data, it is possible. People want to wear these devices because they have the ability to improve quality of human life. Smart phone is no more a device that is used for just calling and messaging although they can use it as a sensor to monitor patient health in real time. Athletes also use wearable devices for measuring their distance in-terms of running, calorie consumption, heart rate and body temperature [16]. Through smart phones everyday natural language processing and sentiment tracking is also possible [14]. The chronic diseases (Asthma, diabetes, high blood pressure etc.) can be predicted easily by uploading the data of chronic diseases provided by user in the software using back propagation algorithm. It is totally based on quality of data that is the better the data the better the prediction. ML is also used in analysis of continuous data used in intensive care unit and in intelligent alarming systems for the effective monitoring of patients [17] [15].

The fast growth of computer science in last decades has been closely followed by the similar advances in molecular biology. Machine learning proved a big set of tools to the biologist for the identification of biological sequences. These sequences are large portion of data biological data that requires computational tools for the analysis. Neural networks, decision tree and support vector machine are served as a tool for the analysis of biological sequences [18] [36].

Recently machine learning has been able to do a differentiation between images of Benign and Malign moles. This can greatly help dermatologists in the diagnosis of various skin diseases that can cause death [19]. ML has been used in reading of complex eye scan and detecting more than fifty eye conditions [20]. Machine learning based Physician Ellie also facilitating the patients of depression and other medical conditions. According to the analysis of their facial expression, verbal responses and vocal intonation Ellie can possibly detects depression and medical conditions. In china millions of people use Microsoft Xiaoice when they need a sympathetic ear. It is based on emotional computing framework and modifies his/her response according to the human reaction [14].

According to a report machine learning and big data in medicine and pharmacy could generate revenue up to \$100 billion annually due to its fast decision making and optimized innovation. Many large companies such as Google and Med-Aware have introduced large projects for medical care based on machine learning. Use of machine learning will help in facilitating more patients in less time and will improve outcomes [21]. The benefits of machine learning in health care are countless but awareness of possible unintended consequences is needed. Skilled clinician must be available while extracting meaningful information from patient's data through machine learning so that educating the next generation of medical professionals with the right ML techniques is considered necessary [22].

## 7. CONCLUSION

Research papers having discussions or information regarding the various applications of machine learning in the sector of health and education have been studied and reviewed. The applications abiding by rules of machine learning or having machine learning algorithms have also been highlighted in this research in the field of health and education (for both). People working in companies/organizations, in educational institutes and in the medical field can benefit from this paper; in-terms of understanding what machine learning is, where can machine learning be applied, how and what sort of tools/systems/applications are based on machine learning in the sector of health and education and furthermore how can people working in the field of computer science can create new or improved versions of the tools/applications presented in this paper so that the people who are not aware of the uprising of technology even in health and education can learn about it, use it and benefit from it.

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