International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Machine Learning and its Scope in Everyday Life

Saraa Kumar

Singapore American School
saraakumar06[at]gmail.com

Abstract: ***Machine learning (ML) is a subset of artificial intelligence (AI), which allows computers to learn by analysing data and predict outcomes without specific code. Humans interact with machines daily - think of Alexa, Siri and Google Assistant. However, ML applications today go beyond these AI assistants. This paper presents specific and relatable examples of machine learning in everyday life and its diverse scope in three crucial sectors: education, transportation, and e-commerce. The noble applications of ML in the education sector like identifying at-risk youth in schools, understanding school demographics and assessing student performance have been discussed. The paper also elaborates on the use of ML by companies in adaptive learning programs. In the transportation industry, ML is used to improve commute times through delay prediction and solving air traffic issues. This paper also highlights the huge impact of ML on e-commerce, namely to target advertising to customers. Several examples of organizations and businesses that use ML make this paper unique and relatable to the reader, thereby fulfilling the purpose of this research. ML has a broad scope of application and its creative use has already made many sectors efficient and user-friendly. It has a bright future in years to come.***

Keywords: Machine learning, education, transportation, e-commerce, artificial intelligence

1. Introduction

Machine learning (ML) is a branch of artificial intelligence (AI) in which a computer is fed data to recognize patterns. The interesting thing about ML is that it enables computers to automatically learn, predict and program without being explicitly programmed. It is commonly used in several sectors like education, transportation, e-commerce, healthcare, food, and social media, among others. Humans interact with machines in everyday life. Alexa, Siri and Google, although not commonly identified as such, are examples of ML. They are virtual personal assistants, which is an application of AI. Another common example of ML is navigation systems such as Google Maps to predict travel times – the machine uses data to predict a certain outcome. Media services such as targeted ads and filtering mail is also a common application of ML; the computer uses a user's data, understands what they like and dislike, and chooses which content to show to the user. Another crucial subset of machine learning is computer vision – the Google Translate camera feature uses computer vision to detect and translate, with high accuracy, any text from another language. While AI and ML are very closely connected, and often mistaken for each other, they are quite different. ML is an implementation of AI: it is a subset of AI, which, like AI, uses data to learn like a human, and to create intellect. Figure 1. presents a schematic view of the relation between AI and ML.

ML can be categorized into four types depending on how the ML algorithm is trained: supervised, unsupervised, semi supervised, and reinforcement learning (Shah, 2020). Supervised learning is the training of a machine with set input and output data. This data is 'labelled', meaning that it is identified with context in order to give the computer required knowledge on the provided data. A few commonly used algorithms in supervised learning are regression, neural networks, and classification. To briefly describe these algorithms, classification uses a program that assigns data into set categories, allowing the computer to create deductions on the way in which such data should be classified. Classification algorithms are used in email-spam detection and filtering. The most common form of regression algorithm is linear regression, in which the predicted outcome has a constant slope, generally used for trend prediction applications.

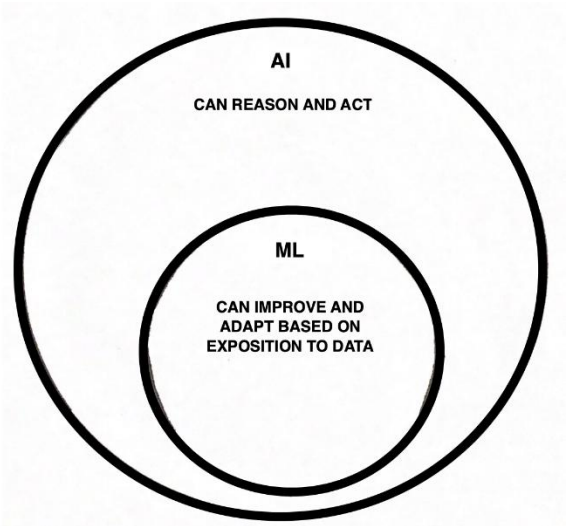

Figure 1: Relation between AI and ML

Unsupervised learning algorithms function without human supervision, which means that the data is 'unlabelled'. The computer analyses patterns and groupings without human intervention. A popular unsupervised learning algorithm is clustering, which separates data based on their commonalities and differences. There are many types of clustering algorithms, K means clustering being the most commonly used. It is a distance-based clustering which means that the computer assesses the distance between the points to attach a point to a cluster. Semi-supervised learning is a mix of the above: it uses a small number of labeled data with a larger pool of unlabelled data, which is beneficial due to the variety of data without the hardship of having to deal with large pools of labeled data. Reinforcement learning, on the other hand, is a strict training-based learning - a reward will be given to desired behaviours, and a negative action to undesired ones. This method allows the computer to learn in an interactive environment with active and engaged feedback through trial and error (learning from mistakes). Figure 2

illustrates the connection between these sectors and machine learning.

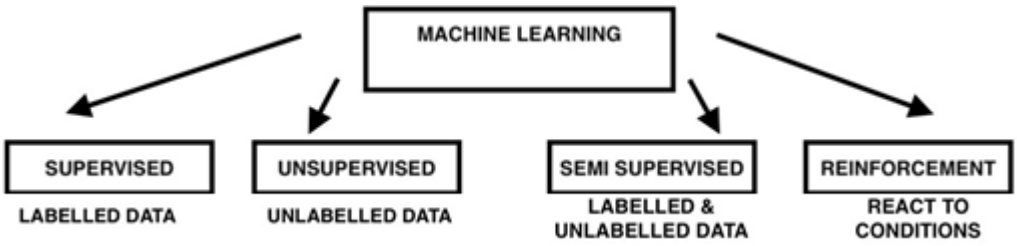

Figure 2: Subsections of ML

ML is used in several anticipated fields, so it is important to note that it is a practice that we – as humans – encounter on a daily basis, and is a great assistant to us. This paper will address the usage of ML in everyday life that often goes unnoticed, including specific business and real-world examples that use ML to improve their respective initiatives. Furthermore, the paper highlights the importance of different ML applications and how it has improved diverse sectors like education, transportation, and e-commerce.

Machine Learning in the Educational Sector

ML applications across the educational sector have transformed it and helped to make educational programs more student-focused. An interesting example is the use of ML-based platforms by teachers of universities and institutions to recognize students in need of support. The computer is able to predict a student's future performance in tests based on past entries and demographics (Davison, 2020). In this section, three crucial areas of ML applications are discussed, namely adaptive learning, predictive analysis and personalized learning, which often overlap in usage.Predicting student performance identifies weaknesses and learns about the student in order to suggest helpful solutions, such as more questions on a certain topic. Popular learning companies like Knewton and ST Maths uses predictive analytics algorithms extensively to improve their services (*St math: A program for Conceptual Understanding* 2022) (*Achievement within reach* 2022). These companies have integrated predictive analytics and adaptive learning (discussed later in this section). Knewton is focused on adaptive learning, and ST Maths is focused more on the interactive, game-oriented side of its services. Predicting performance can be used from any age, kindergarten to even after high school (Kučak et al., 2018). According to expert Julia Harvey, ML algorithms like linear regression classifiers, decision tree classifiers and Naive Bayes techniques are all used to predict performance: between the three, however, the Naive Bayes technique has proven the most efficient in predicting SAT scores.

Adaptive learning is a type of learning that continuously adapts and adjusts the curriculum based on students' performance. Adaptive ML takes in a single channel of data, in sequential order; no outcome is final as long as data is streaming in. This is a celebrated type of ML, as it is accurate and efficient. The data gathered from schools has also been used for decisions, such as graduation rate and cost management. Several universities and educational institutions use these ML applications to predict student performance, improve knowledge retention, and test fairly. Besides the companies discussed above, ALEKS is an adaptive learning program developed by McGraw Hill which maintains a student's knowledge map and provides content based on what the student is ready to learn, based on his current ability (McGraw Hill, 2022). BYJU's also uses a similar program which is self-paced and provides personalized content for each student based on their proficiency (BYJU'S, 2022).

Moreover, a machine can catch at-risk kids early on, and schools can be of assistance right away. For example, in a governmental hackathon in Australia, a program was proposed in which students would design AI "for good" that could be used by schools and law officials (Msauedu, 2020). Testing fairly is, another subsection of education that ML benefits. ML can both accurately and correctly test based on data input of previous student works and correction of those works: this kind of rectification is unbiased, unlike its human counterpart. An example of this is Turnitin's Lightside program, which checks for plagiarism and overall essay competence (*Empower students to do their best, Original work* 2022). In regard to retention, ML can easily make suggestions to certain educational programs to improve student retention. It can identify and rank the most helpful methods for retention, thus promoting the success rate. The examples above demonstrate ML's positive impact on students, teachers and thus the community as a whole.

Machine Learning in the Transportation Sector

Another crucial sector where ML has been advantageous is the transportation sector. Often overlooked, transportation is a department in which ML algorithms can contribute enormously. Making faster, cleaner and more efficient modes of commute is the primary achievement of ML in transportation. Predictive analytics in transportation can predict times and costs in order to make travel more efficient. Delay predictions, traffic management, and company asset management are all AI-driven factions that have improved this sector. In the past few years, ML-based platforms in the transportation industry have increased due to advances in transportation related technologies such as GPS routes (e.g. Google Maps, Apple Maps), thereby providing a larger body of data. This concurrently results in more efficient and accurate travel time predictions. Additionally, in public transportation, acceleration sensor data is used to determine who the driver is. In simpler terms, different modules of data are collected and used to gain unique features of a driver, which thus identifies them (Haponik, 2022). Similarly, Uber uses an ML platform, called Michaelangelo (Hermann, 2020). Michelangelo allows uber teams to easily build, implement and use ML solutions. It can manage and analyse data, teach employees, and handle predictions.

Furthermore, ML has been key in advancing air traffic control. Air traffic control solutions which are based on mathematical equations and modules do not account for real time environmental conflict and factors. Researchers are using data mining to research factors in air traffic. A crucial part of ML, deep learning, is used to attack issues concerning air traffic, delays, and even weather forecasts, with more efficient conflict resolution methods than the others. Aghdam and team studied the use of ML to calculate estimated time of arrival and departure of a number of flights based on large plots of input data from various sources including the bureau of transportation statistics system (Yousefzadeh Aghdam et al., 2021). The team used meta-heuristic algorithms and succeeded in curating the best possible flight control in a 15-minute window. ML in the transportation sector, thus, has a huge scope of expansion and commercialization.

Machine Learning in the E-commerce Sector

In E-commerce, ML is used to obtain a better understanding of customers and customer experience. Customer training and targeting potential users are popular areas where companies are using ML. Customer training allows the machine to understand any concepts relevant to the business, thereby giving the company a wider insight on the customer needs. Pinterest, for example, curated an extension which allowed users to search for similar images by dragging in a selected photo to the web bar (Pinterest, 2022). ML is also used to identify customers' likes in a store based on time spent looking at a product, and then transferring offers based on this information to the computer screen (Chikae, 2021). Applications like facial recognition and computer vision play a vital role here. Computer vision allows computers to make sense of visual information, and make a decision based on that information. Computer vision requires a large data set in order to gain context and recognize objects: convoluted neural networks and deep learning are used to accomplish this. Computer vision acts as the eyes of a machine, and convoluted neural networks allow the machine to "see" by decomposing image inputs to pixel form followed by labelling this data. The machine will then form conclusions, continue to repeat this process and examine the accuracy rate until satisfactory outcomes (IBM).

Another way in which ML has transformed businesses in e-commerce is by improved marketing campaigns. In today's world where data is seemingly endless, ML has all the data needed to help e-commerce businesses make decisions on marketing campaigns based on customer experience. Furthermore, retargeting is an essential part of marketing campaigns. Imagine that customer x is scrolling through an online clothing store, and bags a few summer dresses, but they do not end up purchasing such items. Regardless, the company will mark this customer for similar products in a retargeting agenda and can send emails to customer x when products like these are available. Likewise, Google ads uses ML to optimize digital campaigns, and Google's extremely large data pool makes this task easier (Google Ads, 2022).

ML is not only used in e-commerce for customer related ventures, but also for company improvements like managing stock and company assets. It is important to analyse customer information before making a decision on which method to use. Machine makes this analysis far simpler with algorithms to evaluate aspects like tax, sales costs, and even predict demands. Another avenue in which ML is instrumental in aiding businesses is with direct customer interaction. Chatbots are frequently used in this regard, and although some businesses run into issues with the machine's ability to answer user questions, there have been significant improvements in the recent years. ML "chatbot" systems are also used amongst employees in some companies. According to the Harvard business review, an Italian company developed a program that interacts with company employees using deep learning to aid employee problems by searching up FAQs and solving problems (Davenport & Ronanki, 2019).

2. Conclusion

ML has transformed several domains of our day-to-day life and this paper aimed to identify and address its importance with examples of organizations and businesses. An application-oriented research of ML platforms and features in diverse industries – focusing specifically on education, transportation and e-commerce sectors – this paper establishes the significance of ML both today and tomorrow in creating a more efficient and user-friendly world. Research in AI/ML domains and optimization of algorithms to improve efficiency will render fruitful results in the coming decades. ML-based platforms have the potential to be used at a much broader scale for greater impact; policy makers and consumers must prioritize the future in hopes of more efficient years to come and should aim to implement a transition to data-driven processes now.

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Author Profile

Saraa Kumar is a sophomore at Singapore American School. From a young age, she has been passionate about technology, specifically artificial intelligence and machine learning. She is a teacher's assistant for Advanced Placement Computer Science at her school and spent her sophomore year tutoring children in Computer Skills. She aims to dive deeper into the domain of artificial intelligence and contribute to the world with her research in the coming years.