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APPLICATION OF MACHINE LEARNING IN HEALTHCARE

Management

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ABSTRACT

Significant progress has been made in the areas of disease populations, disease status, immunological response, and health emergency prediction and identification, among others, thanks to recent developments in AI and ML technologies. The use of ML-based approaches in healthcare settings is growing quickly, despite ongoing skepticism about the usefulness of these approaches and how to interpret their findings. Here, using examples, we give a quick rundown of machine learning-based methodologies and learning algorithms, such as supervised, unsupervised, and reinforcement learning. Second, we go over the use of machine learning (ML) in many healthcare domains, such as genetics, neuroimaging, radiology, and electronic health records. We also offer recommendations for future applications and a brief discussion of the risks and difficulties associated with using machine learning to healthcare, including issues with system privacy and ethics.

KEYWORDS

1. INTRODUCTION:

A variety of statistical methods that enable computers to learn from experience without explicit programming are referred to as "machine learning" (ML). Usually, this learning manifests as modifications to an algorithm's operation. An ML system could look at a set of images of different people and identify faces from them. The two main subfields of machine learning are supervised learning and unsupervised learning. One of the biggest sectors in the world that stands to gain from this technology is healthcare [1-3]. Thanks to technological advancements during the past century, the average life expectancy has significantly improved. Even though technology has advanced dramatically in recent years, new developments in the fields ofartificial intelligence (AI) and machine learning (ML) portend a rebirth in the medical field.

Of course, even the smallest and least important components of any process can be nearly perfected with the use of computers. Although machine learning is already used in healthcare, there is still a lot of room for growth in this area [4,5]. Modern technology have always had the steadfast support of the healthcare sector. Similar to business and e-commerce, AI and ML have found numerous uses in the healthcare sector. With this technology, the possibilities are almost endless. With its innovative uses, ML is helping to improve the state of the healthcare sector. Due to mandated processes like Electronic Medical Records (EMR), healthcare systems have already used Big Data tools for next-generation data analytics. This approach will benefit considerably more from the use of ML technologies. These enhance the standard of automation and intelligent decision-making in public healthcare systems and primary/tertiary patient care. Given that ML techniques have the potential to enhance the lives of billions of people worldwide, this may be their most significant effect [6–8]. Machine learning has been applied in many different fields since its inception, from face detection in security services [9] to improving productivity and lowering risk in public transportation [10,11]. In the fight against COVID-19, machine learning applications have lately made it possible to speed up testing and hospital response. Using a deep learning system developed by GE called the Clinical Command Center, hospitals have been able to share, coordinate, and track patients, beds, rooms, ventilators, EHRs, and even personnel during the epidemic [12]. Artificial intelligence has also been utilized by researchers to monitor and identify SARS- CoV2 genetic sequences and to create vaccinations [13].

2. Artificial Intelligence:

Despite their common usage, the terms artificial intelligence, deep learning, and machine learning refer to distinct sets of algorithms and learning procedures. Any electronicintelligence that mimics and learns from human intelligence is referred to as artificial intelligence (AI). Though AI is most commonly associated with autonomous devices like robots and self-driving cars, it is also used in commonplace applications like web searches and targeted marketing. AI research and applications have advanced tremendously in recent years and are now used in a wide range of fields because of their superior decision-making, accuracy, problem-solving, and computing abilities. Typically, when developing AI algorithms, the collected data is divided into two categories: a training and a test data set. This is done to guarantee accurate forecasts, representative populations, and dependable learning. The training set, as its name implies, is used to train algorithms using sets of defining data points (features) and, in the case of supervised learning, associated predictions. The testing data set is exclusive to the algorithm and is used to evaluate its performance. By doing this action, biases in the algorithm's testing by the training dataset are removed. Algorithms are applied in healthcare settings after completing a training and testing process with satisfactory outcomes. The use of artificial intelligence (AI) is widespread and has numerous applied sub-regions; here, we give a summary of two of these sub-regions: machine learning and deep learning.

Machine learning uses a variety of statistical techniques and algorithmic models to address issues without the need for skilled programming. Due to the single-layered nature of many machine learning models, significant portions of feature extraction and data processing are completed before the data is entered into the algorithm. In the absence of further layers, these machine learning techniques necessitate extensive data preparation to provide precise prediction determination and prevent the training dataset from being over- or under-fitted.

Deep learning is a more complex kind of machine learning that makes use of layered artificial neural networks. It offers more precision and interpretability at the expense of less interpretability. The multilayer network that facilitates the connections between the artificial neurons, or units, in each layer and those of the layers before and succeeding it is known as theneural network approach. Using these multilevel links for data processing, these networks are able to learn, perceive, and draw conclusions from data on their own. The data are processed until the desired specialized results are obtained.

The majority of AI and machine learning algorithms are based on various learning strategies.

Supervised learning is a form of machine learning that is utilized to train algorithms for classification and prediction by using examples or outputs from the past. The training set for this learning method differs significantly in that it includes features and associated predictions, or outcomes. To put it simply, the supervised learning approach uses information from the training set's features to generalize and build a model that can accurately predict training-set outcomes. The learnt model is then applied to the testing data set's new features to generate predictions. Unsupervised learning is a subset of AI-based learning techniques that is commonly employed for data evaluation and application clustering.

Instead of being used for prediction, unsupervised machine learning is typically used for data reduction, stratification, and analysis. Unsupervised clustering techniques, in general, use algorithms to organize unclassified data into independent groups. This method enables the extraction of features and investigates possibilities of data clusters by identifying the underlying relationships or features in the data, then grouping them by their similarities. This is done before the input in most forms of machine learning, however. Convolutional neural networks, Deep Belief Networks, and the k-Means method are a few unsupervised learning techniques.

Another technique for learning that is neither supervised nor unsupervised is reinforcement learning. This learning is dependent on reward sequences, much like the psychological principles of conditioning, and it develops a strategy for functioning within a particular problem domain. Reinforcement learning techniques have been called the closest to animaland human learning since they optimize the error criteria and have the ability to affect their surroundings.

3. Need for machine learning in healthcare

3.1 Electronic Health Records

Lockheed was the company that initially launched electronic health records, or EHRs, as clinical information systems in the 1960s. In order to provide a uniform system for the industry, the systems have undergone numerous reconstructions since then. In an attempt to increase productivity and quality of work, the US federal government invested billions in 2009 to encourage the deployment of EHRs in all practices. As a result, by 2015, about 87 percent of office-based practices nationwide had integrated EHRs into their systems. Deep learning applications, such as prescription refills and diagnosis prediction utilizing patient history, have benefited greatly from the BIG data gathered from EHR systems with structured feature data.

This has assisted doctors in making diagnosis and treating patients, and it has greatly improved the accessibility, organization, and quality of care of the data. Access to health records for research purposes has also increased thanks to the standardization of features across datasets.

3.2 Medical Imaging

Medical imaging has advanced significantly with the application of machine learning-based approaches to several imaging modalities, including Computed Tomography (CT), Magnetic Resonance Imaging (MRI), X-ray, Positron Emission Tomography (PET), Ultrasound, and more. This is due to the digital nature of data and the existence of structured data formats like DICOM (Digital Imaging and Communications in Medicine). Numerous machine learning (ML) models have been created to recognize cancers, lesions, fractures, and rips.

3.3. Genetic Engineering and Genomics

Genetic engineering has grown since the adaptable DNA mechanism known as CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) was discovered. Theinvestigation of "programmable endonucleases" has significantly reduced the cost of genetic engineering, streamlined genetic engineering, and aided in the processes of genetic alteration and diagnosis. Though the technology is not flawless, the current use of CRISPR to Cas (CRISPR-associated protein) editing, such as Cas-9 and Cas-13a, has altered genetic editing. A number of machine learning methods for anticipating Cas9 gene editing off-target mutations have surfaced recently. Using deep CNNs (AUC score: 97.2%) and deep FFs (AUC score: 97%), a new software created by Jiecong Lin and Ka-Chun Wong has increased the quality of these machine learning predictions.

4. CONCLUSION

In spite of the fact that the summary shows how far machine learning has come, there is still room for significant future growth. Numerous machine learning innovations in healthcare today are meant to help doctors and other medical professionals treat patients more effectively and with more speed, accuracy, and quality. The difficulties in establishing machine learning algorithms can be overcome by devising and executing enhancements for data gathering, archiving, and distribution, or by generating algorithms for handling unstructured data to compensate for the scarcity of data. Future uses may also result in less expensive medical exams and imaging types, which might eliminate health inequalities and make services more accessible to developing nations and populations with lesser incomes.

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