Empowering Decision-Making through AI and ML: A Focus on Big Data, Healthcare, and the COVID-19 Pandemic

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ABSTRACT

A great deal of terminology pertaining to AI, ML, and deep learning is utilised extensively in today's corporate, healthcare, industrial, and military lexicons. No matter the size of the data, precise prediction and analysis are of the utmost importance in these domains. The exponential expansion and huge transformation of society makes big data a perplexing tool, necessitating enormous human resources to manage and glean useful insights from this mountain of data. So, AI's first step is to analyse massive data using scientific methods, particularly in machine learning, so it can spot decision-making trends and cut down on human involvement. Machine learning, deep learning, and artificial intelligence are quickly becoming more important in this area. By outlining strategies for their advancement and implementation across a variety of decision-making domains, the writers of this piece choose to bring attention to these sciences. The article also emphasises the benefits of AI in healthcare and its impact on the fight against the COVID-19 pandemic. In addition to having the potential to develop and enhance their approach in decision-making, this research finds that these sciences have a substantial influence, particularly in healthcare. Furthermore, in light of the COVID-19 pandemic, artificial intelligence is an essential scientific discipline.

Keywords: COVID -19; Vision; Machine Learning; Deep Learning

Introduction

People are worried that robots would eventually take over their life and make humans obsolete because of how commonplace words like "robotics" and "artificial intelligence" have become. But this is far from how things actually are. The ability to put one's talents, skills, and abilities to use is what sets humans apart from other animals. Creativity, greatness, and intellect are other ways in which people vary from one another. The capacity and talent to resolve issues is the essence of human intellect. The primary motivation behind AI research and development has been the desire to create computer programs that can mimic human intelligence and thus better comprehend and mimic human thought and behaviour. This proves that AI and computers will significantly impact people's lives [1–5]. The capacity of computers and programs to mimic human intellect in terms of learning, judgement, and reaction is known as artificial intelligence (AI). machines do not have pre-programmed. Additionally, the academic discipline devoted to developing software and hardware with the ability to comprehend human behaviour is known as artificial intelligence [1-9].

"The study and design of intelligent systems that include their environment and take measures that increase their chances of success." is how scholars define artificial intelligence. According to John McCarthy, who gave the phrase new meaning in 1955, "the science and engineering of making intelligent machines" is basically what it means. Advancements in deep learning technology have been the most noticeable result of the rapid development of AI in recent years. It relies on creating artificial neural networks that are a close approximation to the human brain; these networks will be able to learn, adapt, and

expand on their own without any help from humans. The power of deep learning technology has been shown in picture recognition, communication, and language translation. Also, tech giants like Google, Facebook, and Twitter are pouring a tonne of resources into research and development of deep learning capabilities and an AI model that can mimic the brain's complexities. Machine learning plays an important role in medical imaging, particularly in the diagnosis of cardiovascular illness, chronic renal disease, brain cancer, the 2019 Coronavirus illness (COVID-19), and the gender of a foetus in ultrasound images taken by pregnant women. Specialists and clinicians rely on machine learning to accurately analyse patient data and provide disease-related diagnoses [6-25].

Therefore, we are living in an era of tremendous growth in artificial intelligence. At this rate, AI will soon overtake humans as man's most trusted partner. Applications and technology have greatly improved human capacities in recent times. This development has come to light following Facebook CEO Mark Zuckerberg's announcement of the Metaverse platform, which aims to bring Zuckerberg's vision of a virtual world to fruition. Using virtual reality goggles, users may enter a computer-generated, three-dimensional replica of the actual world. We don't need to physically move to be able to sit down and converse with one another in three dimensions. The end objective of this platform is to elevate everyday life to a whole new level, where robots and people work hand in hand in the virtual world. Metaverse has the potential to bring artificial intelligence closer to humanity if it is used appropriately.

The most significant contribution of this essay is the presentation of basic concepts related to artificial intelligence, machine learning, and deep learning in a clear and concise manner. Specifically, we show how they are used to big data research and other areas where they are useful to people. In addition, we go over the key methods, techniques, and applications that were used.

Here is the outline of this article. In Section 2, we cover the basics of AI, ML, and deep learning, including what they are, how they work, and the services they offer. In Section 3, we see how AI is making a difference in healthcare. Section 4 concludes the article with its findings [26–40].

Recent Studies

A look back at the advancements in AI, ML, and DL are presented here. Particularly for individuals with an interest in these fields, the data offered is quite beneficial.

The Second Wave of AI

A fundamental component of computer science is artificial intelligence. As a field of study, it entails programming machines to carry out tasks that are often associated with human intelligence, such as learning, reasoning, correcting errors, and programming themselves. The ultimate goal of AI is to program computers to carry out tasks traditionally performed by humans. Some areas of science and technology rely heavily on artificial intelligence. Currently, AI is present in every aspect of people's lives, from farming to healthcare. One example is the use of robots in surgery, which allow doctors to achieve very precise results.

Knowledge acquisition, pattern recognition, reasoning, issue solving, visual perception, and language understanding are all areas where AI has the potential to make strides. Logic, information, planning, education, communication, imagery, and the capacity to move and manipulate things are also crucial in artificial intelligence research, which is in turn very technical and specialised. There are two branches of this scientific discipline: Applied: This is the most prevalent kind, and it encompasses AI systems that can do a single task, such autonomous vehicle operation. What we call "weak" or "narrow" AI is this kind.

Generaliz ed: This is the less frequent kind and involves systems that can handle any assignment since they have adequate power to address any hurdles or unique scenarios. This one is known as robust. Given that AI is still in its early stages of development, there is currently no working example of robust AI [41–66]

Academics are of the opinion that AI methods pose no threat to humanity. Intelligent technologies, according to Yoshua Bengio, a computer science professor at the Université de Montréal in Canada, shouldn't be cause for alarm since they must undergo a long process of incremental improvement. Because it is founded on its impact on fields and concepts that are still in their infancy, it reaches the level that analysts are afraid of. The scope and use of artificial intelligence has no bounds. Computer applications in medical diagnosis, the impact of an Internet-based search device on computers, and the expansion of stock trading operations are all examples of such fields. Cognitive stimulation: using computers to test hypotheses about the human brain and its operations (e.g., face recognition and memory activation) is another remarkable application. Artificial intelligence provides robots the ability to “reason and learn” . Clinical diagnosis benefits from these two abilities. By comparing the X-ray picture of the patient's lungs with its database, a computer program can determine the likelihood that the patient has an infection with a virus like COVID-19. The development of similar applications for various diseases suggests that artificial intelligence has the potential to enhance and supplement medical professionals' ability to diagnose diseases. The use of AI in practice planning has many benefits, one of which is the ability to determine the best course of treatment by combining patient data with that of thousands of similar cases.

Learned by Machines

New terminology has started to appear as a result of the advances in technology in the past few years. The three most common ones are AI, big data, and industry. While these phrases enjoy more widespread use, the idea of machine learning has been gaining traction in recent years. However, , many questions surround machine learning. Machine learning is applied in different sectors and applications today, and its use is increasing gradually. Machine learning is a sub-area of artificial intelligence . Information technology systems automatically learn patterns and relationships from data and gain without being explicitly programmed. Machine learning has been successfully supported in business, investigation, and improvement for many years . Furthermore, machine learning can automatically produce knowledge, train algo- rithms, identify relationships, and recognize unknown patterns. These identified patterns and relationships can be utilized to a new, unknown data set in order to

make predictions and optimize processes. Machine learning algorithms can be categorized into three main divisions:

Decision Process: Machine learning techniques are utilized to create predictions or classifications of specific data, which can be labelled or unlabeled. The outcome of these techniques is to estimate a pattern in the data, which assists in decision making [67-90].

Error Function: This function judges a model's prediction and whether it gives actual or false effects. Additionally, this function has the ability to make a comparison to judge the functioning of the model and verify the functioning of machine learning techniques.

Model Optimization Process: If the proposed model for implementation fits well with the training data set, then the weights will be adjusted to reduce the discrepancy between the proposed work and the model estimation. The technology will repeat this assessment, improve the implementation process, and improve the weights independently until the accuracy is met.

Unlike traditional software development, machine learning focuses on independent learning from data and information. Thus, machine learning technologies learn from data and create their own approach code on their own. These techniques will live in a particular situation and train themselves depending on the circumstances in which they will be.

Machine learning is categorized into three, namely:

Supervised learning: In general, this type includes most of the problems in machine learning, which is characterised by looking at training samples. Each sample is entered as X so that it corresponds to a specific result, which is y. We need to train a model (mathematically is x→y relationship mapping f) in unknown samples x after giving, then we can obtain y predictions. If the prediction is a discrete value (often category types, such as spam/snail mail in the mail classification problem, such as whether a user will/will not buy a particular product), then it will be termed a classification problem. If the prediction result is a continuous value (e.g., apartment prices, stock prices, etc.), then this state will be termed a regression problem [90].

Unsupervised learning: It is a form of learning in which information is categorized or not. Unsupervised learning finds hidden patterns in data. It uses them to infer from datasets entered into the system, without labelled data. Given that no classification has previously been done, the system can classify using data sets.

Reinforcement learning: It is a form of learning that takes place between supervised learning and unsupervised learning. It is used for the same applications as supervised learning. Large amounts of unlabelled data and small amounts of labelled data are commonly used.

The question of whether AI and machine learning are synonymous arises frequently. The following is a breakdown of the ways in which they differ in this section: The goal of artificial intelligence is to increase the likelihood of success rather than precision. Machine learning, on the other hand, is just concerned with increasing accuracy and could care less about success. An clever computer program is what we mean when we talk about artificial

intelligence. Machine learning, on the other hand, is the idea that a machine can take in data and learn from it. Furthermore, AI's ultimate goal is to mimic innate intelligence in order to resolve difficult issues. Machine learning seeks to optimise a machine's performance by learning from data collected for a particular job. So, to sum up, machine learning is a method for gaining knowledge from existing data. Machine learning takes into account just one response, regardless of how ideal it is, but artificial intelligence strives to determine and acquire the best appropriate solution. In contrast to machine learning, which results in information, artificial intelligence (AI) leads to wisdom or intelligence. While AI seeks out optimal solutions, machine learning takes a singular approach, regardless of how good it is. In contrast to machine learning, which leads to information, artificial intelligence (AI) leads to wisdom. Simply said, machine learning is the process by which computers may learn to carry out a task automatically, without human intervention, by means of a collection of algorithms and statistical models. Algorithms for machine learning construct a scientific model mostly from training data samples. Predictions or choices are to be made by the model without expressly programming it to do so. It draws conclusions based on how the data behaves. Accordingly, machine learning models are capable of producing trustworthy judgements or useful, accurate forecasts [11].

In-Depth Education

Is it known to you that deep learning aids COVID-19 fighting investigations [37, 38]? Deep learning, what is it? Does it fit within the broader context of AI? Using techniques like artificial neural networks and simulation learning, deep learning is an area of machine learning that strives to create a model that can solve complicated real-world problems at a level comparable to the human brain [39–41]. Producing meaningful output and effectively mining input for semantic information are the two main deep learning tasks that any model must meet. Deep learning, at its heart, is an attempt to mimic the human brain by using artificial neural network techniques; the biological brain is composed of a network of neurones [42, 43]. Each of its three layers—an input layer, an output layer, and one or more additional hidden layers—involves a network of interconnected weighted nodes or neurones. Analysis (comparing and contrasting) and synthesis (integrating information in a new dimension) are high-level cognitive abilities needed for deep learning. The concept and practice of lifelong learning are both enhanced by deep learning [44–46]. Deep learning is characterised by its emphasis on meaning-centered learning, its ability to integrate new information with existing bodies of knowledge, its ability to bridge the gap between theoretical understanding and practical application, and its promotion of analytical thinking and critical thinking. Fast learning is a hallmark of deep learning since it can process massive volumes of data at a fraction of the time it takes a person. With this in mind, deep learning has the potential to make inferences and generate concepts that people just can't. Many fields can benefit from deep learning, including agriculture, weather prediction, and picture identification. It has also found use in the medical and automotive industries. Consequently, AI has played a pivotal role in enhancing human life and society as a whole.

Recurrent neural networks (RNNs) [48] and convolutional neural networks (CNNs) [47] are the two most common kinds of artificial neural networks. First, convolutional neural networks (CNNs) vary from regular matrices in that they use filters to extract features, and

then, instead of using matrix multiplication, they use convolutions to correlate information across their many layers. Among CNNs' many uses are image processing, pattern recognition, and computer vision. Contrarily, RNNs are an improved form of CNNs that incorporate an internal memory to hold all the calculations required to solve the sequential data issue. Long short-term memory [49] has been proposed as an enhancement to RNNs for training data that is long-term, as RNNs are not very good at processing long data sequences and have limited tables. In addition, a lot of work goes into using deep learning to provide massive volumes of categorised data; for example, creating an autonomous vehicle needs millions of photos and hundreds of hours of video. Deep learning is an unparalleled endeavour that necessitates powerful computational resources. The parallel design of modern graphics processing units is well-suited to this field of study. Cloud computing and clustering make it possible for community teams to build deep learning networks in hours rather than weeks.

"Deep" is a phrase that many people wonder about; what does it mean? A neural network is considered "deep" if it has several hidden layers. A deep learning neural network can have up to 150 hidden layers, whereas a traditional neural network only has two or three. This sum proves that deep learning can train a structural neural network with large amounts of data. It finds use in several domains, one of which being recommendation systems. Amazon and Netflix, for instance, have made a name for themselves in the app industry by popularising a recommendation system that helps them gauge user interest in certain content and goods. The suggestions are derived by the way a user searches or watches content. The Netflix suggestion mechanism is seen in Figure 3. You may choose from a variety of deep learning frameworks, including Tensorflow, Pytorch, Caffe2, MXNet, CNTK, and PaddlePaddle. alternative Tensorflow

Keras is a well-known wrapper that can be used to build a model with just a few lines of code. It is straightforward to use, controls nearly every detail, and is convenient, but it doesn't have the versatility that Tensorflow does.

The Necessity of AI in the Medical and Health Sectors

The use of AI has been exponentially growing in the healthcare industry, particularly in the areas of patient admissions forms and the prevention of discount surges at reception desks [51]. Modern medicine has benefited from advancements in artificial intelligence, which have allowed for better disease detection (e.g., cancer [52], infections [53–56]), surgical robots [57, 58], and overall healthcare system improvement. The medical profession is undergoing a transformation as a result of the advancements in artificial intelligence, which have allowed them to effectively solve difficult problems in healthcare management systems. This will help society eliminate wasteful methods. From hospital or clinic workflow management to medication research and diagnostics, artificial intelligence has several applications in healthcare [59]. Here are some examples of the many medical and scientific applications of AI: medical diagnosis and detection, cancer detection, chronic condition management, drug development, robot-assisted surgery, health care delivery, and scientific testing and studies [60, 61].

With COVID-19, we have seen firsthand how AI may aid in the fight against illnesses. The global community has been grappling with the devastating effects of the COVID-19 epidemic since March 2020 [62] [63]. There have been widespread lockdowns, curfews, border closures, social distancing, travel restrictions, school closures, bans on public gatherings, mandatory quarantine of contacts who are not ill, and isolation of patients in hospitals as a result of this disease [64–67]. Everyone has felt the many physical, mental, monetary, social, and cultural impacts of the COVID-19 epidemic and its accompanying health protocols to differing degrees, but those impacts have been most felt by those directly involved with patient care, education, and healthcare delivery [68–72]. Scientists and other professionals have been rushing to find ways to employ AI in the fight against the epidemic. The battle against the COVID-19 epidemic has thus far made use of several deep learning and artificial intelligence technologies and approaches [73] [74]. Using medical imaging and practical algorithms, these applications can detect and diagnose infections quickly and accurately; automatically track and predict the spread of the virus; identify patients at high risk; and forecast the number of COVID-19 cases and mortality rates in any region by analysing patient data adequately [73]. Another use of AI in social control is the enforcement of social distance and lockdown procedures, as well as the use of thermal imaging to screen public areas for those who may be infected [75] [76].

Vaccination, one of the most cost-effective health treatments to prevent infectious illnesses, is the best chance for resolving this catastrophe, with herd immunity and a curative medicine for this virus [77]. Through the analysis of existing COVID-19 data, artificial intelligence proves to be an invaluable tool in the creation of vaccines and drug delivery systems. In addition, this technology is a potent instrument for expediting real-time testing, which is a task that may be impossible for a human to complete given the length of time required by conventional testing. One of the major obstacles in the fight against COVID-19 is vaccination reluctance; artificial intelligence might assist with this [78]. A recent French research found that persuading more individuals to be vaccinated through conversation with a chatbot might greatly reduce vaccination reluctance [79]. When it comes to combating COVID-19, however, artificial intelligence systems are still in their infancy and aren't doing anything. Missing data, excessive outliers, and noisy data limit the utility of this technique [80, 81].

The area of early illness diagnosis is one where artificial intelligence has recently achieved outstanding success, raising great hopes. Wearable apps and technologies also make use of AI methods to detect disruptions to the body's vital signals. They are able to foresee potential health crises and prepare for them in advance. These days, businesses are trying to expand their product lines by utilising AI strategies. As an example, a wearable device created by the American platform CarePredict may detect subtle shifts in the elderly's behaviour patterns that can indicate impending sadness, malnutrition, or falls. As an added safety feature, the device can quickly and efficiently transmit distress signals. Accurately treating patients requires a thorough understanding of their unique genetic composition, lifestyle factors, and drug reaction in order to choose the optimal medication. Within this framework, ongoing research suggests that the integration of AI with medical professionals can have a beneficial effect, leading to precision medicine. This field uses deep learning techniques to

examine genetic data from numerous individuals, detect individual variation in drug responses, and aid in real-time clinical decision-making. Consequently, doctors are able to prescribe the best medicine for each individual patient. While convolutional neural networks (CNNs) are the go-to method for illness detection, classification, and identification, deep learning and computer vision are the tools of choice for medical picture analysis. Machine learning, together with computer vision, can thus do better than radiologists in identifying cancerous tumours in photos. Researchers have started constructing clinical scientific studies using AI approaches, in fact.

Government agencies and global health groups will be slow to accept AI as a trustworthy healthcare ally. Applications of this technology include data analysis, which necessitates machine learning for natural language processing. One of the most well-known AI technologies used in healthcare is contextflow, a search engine that uses 3D medical pictures. The engine has the ability to use the illness kind to determine which regions should be reviewed for reference cases. Furthermore, by utilising context flow, one may restrict search results to certain age groups, genders, or pathological findings stated in the reports. This is achieved by text search and linked medical references.

Conclusion

Machine learning, deep learning, artificial intelligence, and its potential applications are all discussed in this article. Since Alan Turing "cracked the Nazi code," artificial intelligence has been steadily improving. This branch of study is now standard fare in all technological products. The widespread use of AI in several sectors, such as the automotive and entertainment industries, demonstrates that the technology knows no bounds. Now that we are in the big data age, healthcare providers analyse patient data with the help of artificial intelligence algorithms. Analysing data that is either missing or imbalanced, or that has high computing needs, or that has been executed, is not an easy task. Due to insufficient model knowledge, algorithms in machine learning and deep learning ignore imbalanced and/or missing data. This phenomenon is known as "overfitting," and it has the potential to produce an inaccurate model. We have no idea how far machine learning and deep learning have come or where they will take us, but they are rapidly improving and expanding for the benefit of humanity and modernisation. Machine learning and deep learning models are highly recommended in this article due to their exceptional predictive and decision-making capabilities. The higher the amount of data, the better these models become at analysing it, which speeds up the completion of tasks. Research on the effects of artificial intelligence on COVID-19 patient data will be considered at a later date.

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