The Role of Machine Learning In Natural Language Processing and Computer Vision

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Abstract- ***Research and development in artificial intelligence and its associated domains and subfields, such as machine learning, deep learning, and natural language processing, have undergone tremendous growth over the past several years. This increase may be attributed to the rise in popularity of these areas of study. As a result of the availability of a vast diversity of applications and the declining cost of computer systems, researchers have discovered a renewed sensation of excitement in the job that they do. In the modern world, I believe it is fair to state that artificial intelligence and the subfields that fall under its umbrella have been having a favourable impact on a wide variety of business sectors. Machine learning and deep learning not only make companies more efficient, but they have also had a substantial influence on various subfields of artificial intelligence, such as computer vision and natural language processing. Both of these types of learning increase the efficiency of enterprises. Learning techniques have played a very essential part in ensuring that correct analysis is carried out in the field of natural language processing, which refers to the capacity of computers to comprehend human languages. This is a challenging endeavour. In this study, we focus on the significant part that learning strategies play in enhancing the productive capacity of natural language processing.***

Indexed Terms- Machine Learning, Deep Learning, Natural Language Processing, Artificial Intelligence.

I. INTRODUCTION

Over the course of the past several years, the subfields that fall under the umbrella of artificial intelligence, such as machine learning and natural language processing, have been gaining more and more attention. When it comes to constructing an artificial 'intelligent' agent, one of the most critical phases is to make use of machine learning and natural language processing.[1] The advancement of Natural Language Processing has made it feasible for AI systems to better perceive their surroundings and respond in a manner that is user-friendly in response to their improved comprehension of those circumstances.

On the other hand, the term "Natural Language Processing" refers to the operation of a computer system that comprehends and processes natural languages. The only language that a computer can comprehend is the language of 0s and 1s, which is called binary.[4] Through the use of Natural Language Processing, the computer was able to comprehend both English and Hindi. Natural Language Processing (NLP) has received rapid adoption in recent years thanks to the simplicity with which it may be utilised. Every electronic gadget, from air conditioners and ovens to ceiling fans and light bulbs, can be controlled remotely. You can use your voice to control anything from the music to the lights to the air conditioners, which makes these electrical goods smart...!! All of this is made possible by an NLP system. Even though NLP has made interacting with complicated electronics much easier, there is still a significant amount of processing that takes on behind the scenes in order for this to take place. Learning algorithms have been of significant assistance in improving the processing of the language. An Artificially Intelligent System may more precisely forecast its behaviours and interpret the information it has received after adopting the techniques of Machine Learning. [2,3]The system is able to learn from previous experiences thanks to the application of machine learning. A generic algorithm executes a predetermined sequence of operations in accordance with what it has been programmed to do, and thus is unable to solve issues that it has not been given instructions to solve. In addition, the majority

of situations that occur in the real world contain a large number of variables that cannot be predicted, which renders standard algorithms inefficient. Throughout every stage of this procedure, machine learning is a very important component. The ability of machine learning algorithms to handle unknown issues by using examples from the past has significantly improved in recent years.

The identification of spam in email is one of the most common instances presented. There are a lot of unknowns involved in the process of determining whether a communication is real or spam and labelling it as such. There are a variety of methods that spam filters might be avoided being used. In a typical algorithm, hardcoding each and every feature and variable can be an exceedingly challenging and time-consuming endeavour, if not completely impossible. On the other hand, a machine learning algorithm possesses the capacity to acquire knowledge and develop a general rule when presented with the aforementioned environment.[5,6] It is a possibility that the linguistic information is ambiguous or includes ambiguities in some form. In order to clear up any confusion that may have been caused by the newly revealed linguistic information, a number of different NLP procedures, including POS, NER, SBD, word sense disambiguation, and word segmentation, are utilised. The resolution of ambiguities and the accumulation of all linguistic information are both significantly aided by models of machine learning, which play an essential part in both of these processes.[7,8] There are some advanced natural language processing algorithms that are based on statistical machine learning, while others are fully supervised and need just human input. In the past, all natural language processing (NLP) operations were completed using a variety of rule-based methodologies, which required the human compilation of extensive rule sets. Machine learning employs a different paradigm than the majority of the earlier language processing projects that were attempted. In the research that has been done on various NLP tasks, a wide variety of ML techniques have been thoroughly investigated. Machine learning algorithms can be parametric, nonparametric, or kernel-based, depending on their design. During the training phase of a method that is based on machine learning (ML), ML algorithms are trained on a sufficient amount of pretagged data to create model data. Subsequently, the model data are utilised during the testing phase to test new data. However, stochastic machine learning has emerged as the primary focus of study in recent years. In this kind of model, a real-valued weight is assigned to each feature that is read in, which results in probabilistically fuzzy decisions being made. The advantage of using such models is that they may describe a relation quality in several dimensions. These models are beneficial.[9,10]

Through the use of artificial intelligence, computers can gain intellect and the ability to make judgements. Both artificial intelligence and natural language processing (NLP) are made possible on the platform thanks to machine learning and NLP, which also makes it possible for the platform to achieve its machine learning goals in a more efficient manner. Because of this, machines now have higher standards for human performance.[13,14] Learning using machine systems has found application in a variety of disciplines. In addition, natural language processing is used in a wide variety of fields, such as search auto correction, auto complete, language translators, social media monitoring, chatbots, target advertising, grammar checkers, email filtering, voice assistance for recommendations, and other areas of research. These applications are just some of the many uses of natural language processing.

- The Processing of Natural Language with Machine Learning

In recent years, Natural Language Processing and Machine Learning have become more important subfields of AI, finding applications in many different types of businesses. Computers are able to tackle issues that weren't specifically intended for them to do so thanks to a technique called machine learning. It is nearly difficult to explicitly programme or design an algorithm that can anticipate all possible input types and tackle the task at hand due to the many real-world applications that make this virtually impossible. Deep learning and machine learning are two approaches that enable computer systems to learn from data and draw their own conclusions.[11,12] This enables the computer system to address problems that it may not have come across in the past or to enhance its answer based on the experiences it

has had over the course of time. Because of their capacity to learn from a vast amount of data, machine learning and deep learning have become prominent approaches in recent years. These techniques may be utilised in a multitude of fields, including healthcare, transportation, customer service, and more. For this reason, machine learning has been steadily gaining popularity over the course of the past several years.[15]

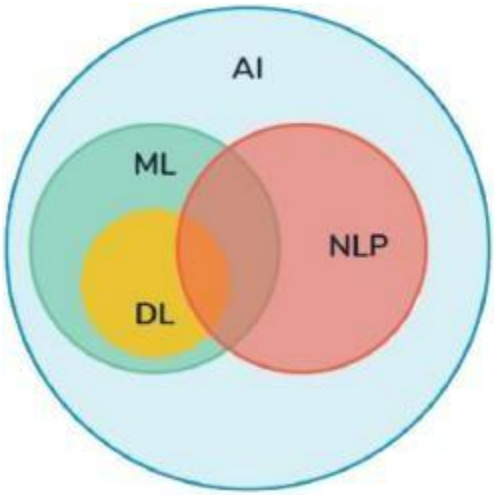

Figure1:AI,ML,NLP[16]

Because of the accessibility of low-cost, high-performance computer systems and enormous volumes of data that can be mined for the purpose of gaining new insights, Both machine learning and deep learning have seen a surge in interest in recent years. The versatility of machine learning's potential applications is a major factor in the technology's meteoric rise to prominence. Manufacturing, healthcare, transportation, automobiles, e-commerce, insurance, customer service, and energy are just few of the many sectors that might benefit from this. have all incorporated machine learning into their operations, with positive results. The intelligence of computer systems has been considerably improved because to advancements in both machine learning and deep learning.[17,18] Nevertheless, making use of these intelligent systems can be a challenging endeavour. In addition, only a small number of engineers specialising in machine learning were able to use or communicate with these clever machine learning systems. Natural language processing has made it feasible to communicate with intelligent systems in human languages. This capacity to interact with intelligent systems in human languages has, in a way, brought these systems to the general market.

It is a branch of research that incorporates a wide range of disciplines, including linguistics and computer science, among others. Processing of natural language is another key topic that falls under the umbrella of artificial intelligence. The goal of this project is to give computers the ability to interpret human language, whether it be spoken or written.[19,20] The process of comprehending a statement spoken in a natural language is challenging. The inherent ambiguity that exists inside languages makes the completion of this task that much more difficult. An example of ambiguity is the fact that a single word can have more than one interpretation depending on the surrounding circumstances. For example, the term "bank" can refer to either a financial organisation or a slope below a body of water. As a direct consequence of this, computers have a more difficult time comprehending human language.

There are a number of different phases involved in the processing and analysis of human language. At each level, there is the potential for a morphological analysis, a syntactic analysis, a semantic analysis, a discourse analysis, or a pragmatic analysis to take place. This level of analysis establishes whether or not the computer is capable of processing and comprehending natural language. Processing natural language has developed into its own independent subfields of research as well in recent years. The digital assistants Siri, Alexa, and Google Assistant have contributed to the rise in popularity of natural language processing. Natural language processing technologies offer corporations not just these advantages but also the potential to save millions of dollars in the process. The expenditure of billions of dollars on research and development in the field of natural language processing might be justified for a variety of reasons.[21]

The increasing popularity of natural language processing can, at least in part, be due to the fact that it can be utilised in a variety of practical settings. Chatbots, also known as Conversational Agents, Text Classification, and Information Retrieval are just few of the applications that natural language processing

may be used for. Other applications include Sentiment Analysis and Machine Translation. By interacting with one another, researchers in a variety of subfields of artificial intelligence have been able to improve the efficiency and accuracy of their work. For instance, natural language processing has been very important to the development of robotics, and machine learning has been important to the development of computer vision, which is a branch of artificial intelligence. Both of these things have contributed to the success of the overall area of artificial intelligence. There are still many obstacles to overcome in the field of natural language processing (such as research that has been done on computer interfaces). [22,23]People who are interested in robotics, automation, and the transformation of digital technologies now have access to a wide variety of possibilities as a result. In a similar vein, machine learning has been an extremely significant factor. Processing of natural language relies heavily on it for its functionality. Whatever the circumstances The steps or types of analysis involved in natural language processing Deep learning and machine learning have been quite helpful in a lot of the different applications that natural language processing has been used for. They are an extremely important contributor to the enhancement of their productivity and precision. As a result, the purpose of this study is to give a review and bring attention to this crucial problem . Learning strategies based on machine learning and deep learning also play an essential part. Improving the effectiveness of processes that deal with natural language.[24]

- NATURALLANGUAGEPROCESSINGANDLEARNINGTECHNIQUES

Machines only comprehend binary, not human language. Processing tasks help machines grasp human language. You must identify words and sentences for a stream of letters, verify whether the sentence identification fits language rules, extract or interpret the phrase's content, and make sense of it. You must determine the sentence's meaning and intent. Morphological, syntactic, semantic, discourse, and pragmatic analysis are the five tasks. Machine learning methods like Naive Bayes, Support Vector Machines, Decision Trees, Random Forests, and Recurrent Neural Networks and Convolution Neural Networks have improved practically all industries.[25,26] Figure 2 depicts natural language processing phases. For natural language processing, these steps must be done sequentially.[27]

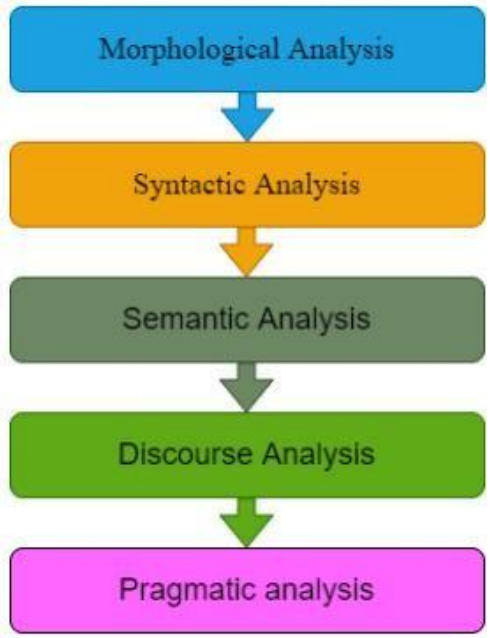

Figure2: Stagesin Natural Language[28]

- Morphological Analysis

Natural language processing begins with word and sentence identification. Tokenization occurs. Affixes can mislead machines in these words. Stemming removes these affixes. Morphological natural language processing includes tokenization and stemming. Morphological tokenization is crucial. To increase tokenization efficiency, machine learning methods have been investigated recently. This computer receives 0s and 1s. Zeros and ones ASCII converts 1s to alphabets. A computer gets a sentence or paragraph as characters. Analyse morphologically. First, identify words and sentences.[29,30] Tokenization identifies. Support Tokenization techniques include Vector Machines and Recurrent Neural Networks. The system captures words and phrases after tokenization. Most sentences have affixes. Affixes make it nearly hard for robots to create a dictionary of words with all their conceivable affixes. Remove these affixes next in morphological analysis. Stemming or lemmatizing removes these affixes. Random forests and decision trees work well for stemming.

- Syntactic Analysis

Natural language processing next checks a sentence's grammar. First, categorise words. This helps syntactic parsers check grammatical rules. Random forests and recurrent neural networks have been used for this job. K-nearest neighbour has been used to build syntactic parsers. NLP uses four fundamental English language principles to verify if statements match language rules.

- Acompletesentencerequiresasubjectandaverbandexpressesacompletethought.[31]
- Separate ideas generally require separate sentences.
- English word order follows the subject-verb-object sequence (Ram(S) plays(V)Cricket(O)).
- A dependent clause contains a subject and a verb.

There are a lot of other rules in the language that are much like these ones. In order to qualify for and successfully complete syntactic analysis, the following statements need to be followed. The examination and investigation of The structure of the phrase is a crucial component to consider. The interpretation that best fits the given text.[32,33] There are well-established rule-based parsers that can parse a sentence and check the syntax of a sentence since the rules of a language are often thoroughly stated, and there are no changes in these rules. As a result, there are well-established rule-based parsers. Syntactic analysis has not benefited significantly from the development of approaches for learning with because of this reason.

- Semantic Analysis

The following phase, which comes after the syntactic analysis stage, is to comprehend the meaning of the sentence based on the sentences themselves. This is done after the syntax has been validated and confirmed during the syntactic analysis stage. This process of comprehending the meaning of the phrase may be accomplished by utilising word dictionaries and word-meaning dictionaries.[34,35] The processing of natural language now moves on to the next stage, which is the semantic analysis step. It is in the very nature of a language to have ambiguities, and this is especially true for the meanings of individual words. There are certain to be a great number of words in every language that may be interpreted in a variety of ways and convey a variety of senses. There are a great number of words that, depending on the context in which they are used, may convey a variety of distinct meanings. In most cases, their interpretations are determined by the surrounding circumstances.

For instance, the term "Bank" might refer to a financial organisation, a warehouse of some type, or even a riverfront. All of these meanings are included in the word. It becomes difficult for a machine to determine which meaning to take. So, even This phenomenon, which is referred to as word sense ambiguity, occurs when utilising word and meaning dictionaries, and it makes it difficult to determine the real sense of a particular word when applied to a certain situation. In light of this, separating apart the many meanings associated with this term is a very crucial step that has to be taken before proceeding with semantic analysis.[36,37,38]

Word Sense Disambiguation is an essential research subject that is still being explored even today due to the various aspects that need to be considered when carrying out the work. This is one of the reasons why the problem is still being researched. Word sense disambiguation has been seen as a classification issue, and various learning strategies, including machine learning and deep learning, have been applied in an effort to resolve the ambiguity that exists in the meanings of various words. In light of the significance of separating several meanings associated with a single word, numerous research works have attempted to address this issue for a wide variety of linguistic varieties.[39]

- Discourse Analysis

There are situations in which a sentence might begin with a pronoun, or the sentence might refer to a subject or object that is absent from the current sentence. Consider, for instance, the following two sentences: "Ram is a fantastic way to go. Cricket is one of his favourite sports. The existence of the pronoun 'He' causes the second sentence to be completely incomprehensible if one were to examine it in isolation. The meaning of the second sentence won't become clear until the first sentence and the second sentence are considered together. He is talking about the individual known as "Ram" here.

This is a type of analysis called discourse. When performing discourse analysis, there are some examples and cases that are more difficult than others and need to be addressed by the system. Take, for instance, the following two statements into consideration: "Ram went to Shyam's shop to take a look at the newly released cricket bats. Even if the first sentence is also taken into consideration, the words "He" and "it" in the second sentence of the above example can refer to a wide variety of various objects depending on the context.[44,45] The pronoun "he" can be used to refer to either "Ram" or "Shyam," while "it" can be used to refer to either the "shop" or the "Cricket Bat."In circumstances like these, conducting a sentence analysis and determining what the true meaning of the statement is can be a challenging task. In these kinds of situations, it is not sufficient to simply have knowledge of the sentences that came before; rather, some kind of approach is required in order to handle such difficulties with references. The process of resolving cases like this, which is carried out in discourse analysis, is referred to as Reference Resolution. Reference resolution is a fairly active topic of research in and of itself, as was indicated before.[40,41]

- Pragmatic Analysis

In conclusion, there are a lot of situations in which the meaning that is written down and the meaning that was actually intended can be two entirely different things. In these kinds of situations, having an understanding of the meaning of the statements through semantic analysis is not enough. Therefore, in order to determine the meaning that was intended for a certain sentence, a pragmatic analysis must be performed. Take, as an illustration, the phrase, "The soldier fought like a lion." The meaning when taken literally does not make any kind of sense at all. The literal interpretation of the line is that the soldier fought with a great deal of ferocity, which is also the meaning that was intended for it. The examples that were provided illustrate how necessary it is to do pragmatic analysis.[42,43]

The automatic identification of sarcasm by a machine is one of the most complex tasks involved in natural language processing. It is also one of the tasks that has kept a large number of researchers interested and motivated in their work. A statement that is made with the intention of being satirical and giving the opposite interpretation to what has been said is known as sarcasm. One of the most well-known applications of pragmatic analysis is the detection of sarcasm, which may be done automatically.[46,47]
Consider the following example: "This morning I was in my restroom when I slipped and fell. What a wonderful way to kick off the morning! The second sentence has an upbeat and optimistic tone through its semantic meaning. On the other hand, the interpretation that was intended was the complete opposite. Actually, it is a form of the expression "aghast." The goal of pragmatic analysis is to determine the meaning that was intended for such statements. In the field of natural language processing, pragmatic analysis, in general, as well as automatic sarcasm detection, has been one of the topics that has received the most attention and research. The proper identification of sarcasm has been the subject of a significant amount of scholarly effort put in by a wide variety of researchers. In order to effectively identify sarcasm, numerous different machine learning and deep learning algorithms have been tested and evaluated. For the purpose of sarcasm detection on Twitter data, machine learning methods such as K-Nearest Neighbour, Support Vector Machines, and Random Forest algorithm have been utilised. In addition to the usage of these machine learning algorithms on their own, approaches from machine learning have also been employed in conjunction with rule-based systems in order to achieve greater detection accuracy.[48]

- Sentiment Analysis

Analysis of customers' feelings or attitudes towards a certain product is referred to as sentiment analysis. In the field of customer relationship management (CRM), sentiment analysis is playing an increasingly essential role. Even a one nasty comment may change something. A single unfavourable review can completely destroy a product's reputation. In recent years, deep learning has become an increasingly fashionable technique for analysing emotion. It is worth noting here that new deep learning approaches have been developed specifically for analysis of feelings. This is the level of research that is now being carried out for sentiment analysis using deep learning, and it is an interesting information to take

into consideration.

- Chatbot Systems

Conversational interaction with users is what chatbots are all about. Their job is to make that happen. This chat can take place via voice or text exchanges. The widespread use of personal assistants such as Amazon's Alexa and Google Assistant has opened the way for the development of chat bot systems and illustrated how straightforward it is to engage in conversation with end users. Although it may appear simple at first, creating a chatbot that is capable of taking the position of a human agent is a really difficult task. This involves not just the understanding of natural language but also the generation of natural language. Using frameworks such as Google's Dialogue Flow, IBM's Watson AI, and Amazon's Alexa AI, it is simple to create a chat bot system. Every one of these frameworks makes use of deep learning architectures that are intricate and proprietary.[49]

- Question Answering Systems

A question answering system is one that, as the name suggests, aims to provide answers to the questions posed by users. In recent years, the line that used to separate question-and-answer systems and dialogue systems has become increasingly blurry. Chatbots are used to perform the duty of answering inquiries most of the time, and it is true that the majority of the time, they are automated. It is effective in both directions. As a result, the research projects that have the goal of establishing a chatbot system will, in most cases, also result in the development of a system that can answer questions within the chatbot itself. Question Processing, Information Retrieval, and Answer Processing are the three elements that make up a question answering system. Techniques of machine learning and deep learning have been instrumentally important in each of these three components throughout their whole. Specifically, Question Processing has been the focus of a significant amount of study. It is of the utmost need to comprehend the inquiry in order to get more fruitful information retrieval. The processing of questions is seen as a classification challenge, and several research works have studied the use of deep learning techniques to enhance the categorization of questions.

- Machine Translation

The objective of a machine translation system is to convey the meaning of a text written in one language into another language with the intervention of humans doing the translation only in limited circumstances. One of the most prominent instances of a machine translation system currently available is Google Translate. The use of a translation system that literally converts one language's words into another's words is insufficient due to the fact that the structure of a phrase might vary from one language to another. For the formation of sentences, for instance, English makes use of the Subject-Verb-Object structure, whereas Hindi makes use of the Subject-Object-Verb format. In addition to this, there are a great number of other regulations that must be observed. All of these factors contribute to the difficulty of a project that involves machine translation. Recurrent neural networks, as well as their offshoots such as Long Short Term Memory and Gated Recurrent Unit, which are able to function in either direction, have been widely investigated and used for the purpose of machine translation. For these neural networks to provide an accurate translation, it is necessary for them to be able to remember contextual information. In addition, convolutional neural networks have been subjected to a battery of tests, with contradictory findings emerging from each one. As a direct consequence of this, a substantial amount of investigation is now being carried out into the opportunities that may be realised in the field of natural language processing by using the principles of machine learning and deep learning. The fact that these learning algorithms make a contribution to almost all aspects of natural language processing and the applications of this subject should not come as a surprise to anyone. Each of the many natural language tasks and each of the many applications of natural language processing has its own specialised area of research, and vice versa. At the moment, Machine Learning and Deep Learning are the topics of extensive study in all of these many fields of research, and the outcomes have been very fruitful so far. In conclusion, Natural Language Processing (NLP) and the applications that it has allowed have benefited tremendously from the use of Machine Learning as well as Deep Learning.[50]

CONCLUSION

Artificial intelligence (AI) has had a resurgence in popularity over the past two decades, particularly in the critical subfields of machine learning and natural language processing. Techniques using machine learning and its subfield of deep learning have brought about revolutionary change in many areas of the commercial world. These learning strategies have, in point of fact, been beneficially applied to a wide variety of other technologies as well, one of which being natural language processing. There are five essential tasks involved in natural language processing, the successful completion of which gives a computer or other computing device the ability to comprehend human language. The amount of knowledge of natural language possessed by the machine is directly proportional to the precision with which these activities are carried out. The paper demonstrates how machine learning and deep learning approaches have been effectively engaged in executing the majority of these tasks, and it also demonstrates the extremely good outcomes that these techniques have achieved as a result of their application. Having said that, there is still a significant amount of room for study in the direction of boosting the effectiveness with which various activities of natural language processing may be carried out. Additionally, this calls for additional research and study in the field of natural language processing. In view of the fact that learning approaches play such an essential part in natural language processing, it is reasonable to anticipate that the effectiveness and precision of natural language processing will be able to be enhanced via more research and experimentation with a variety of learning strategies.

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