

Machine Learning and Deep Learning Applications-A Vision[☆]

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ABSTRACT

The application of artificial intelligence is machine learning which is one of the current topics in the computer field as well as for the new COVID-19 pandemic. Researchers have given a lot of input to enhance the precision of machine learning algorithms and lot of work is carried out rapidly to enhance the intelligence of machines. Learning, a natural process in human behaviour that also becomes a vital part of machines as well. Besides this, another concept of deep learning comes to play its major role. Deep neural network (deep learning) is a subgroup of machine learning. Deep learning had been analysed and implemented in various applications and had shown remarkable results thus this field needs wider exploration which can be helpful for further real-world applications. The main objective of this paper is to provide insight survey for machine learning along with deep learning applications in various domains. Also, some applications with new normal COVID-19 blues. A review on already present applications and currently going on applications in several domains, for machine learning along with deep neural learning are exemplified.

1. Introduction

Machine learning, a sub-class of artificial intelligence as shown in Fig. 1. It is self-learning based on algorithms that mean the system learns from its experience. For instance, the type of data given input to the system learns the pattern and responds from its learning at the output. In this case, the system becomes smart, smarter, and smartest with time without human involvement. It uses a statistical learning algorithm that automatically learns and improves without human help. On the other side in a deep learning system, it learns from its experience but a large database or large information provided at input. Deep is the term that refers to several layers in between the input and output of a neural network whereas in shallow neural networks maximum of two layers are present in between the input and output neural network. Artificial intelligence is a wide discipline of generating intelligent machines. Mostly artificial intelligence work includes machine learning as intelligent behaviour needs extensive information or knowledge. Technologies never stop to imitate human intelligence, that's why AI has gained tremendous attention now. Most researchers in the computer field have done work since the 1950s on machine learning. So, the expectation from the machines gets higher whereas deep learning attempt is continued in this direction and also gained a lot of attention with the effect of COVID-19 pandemic [1]. Various applications like face recognition have gained

attention in the contact-free world because it provides great authenticity to humans as every person's face is unique. Moreover, the health sector, face recognition attendance system, banks with face ageing and face recognition, retailer, travel, airports, amazon Alexa, google home for voice help, YouTube, Netflix for recommendation system, search engines for a translator, and much more business are switched to use machine learning technology to enhance their system during and post-COVID-19 pandemic [2,3]. Plenty of work has been in various areas using machine learning. Doing the research with new, upcoming areas and existing areas for improvement is always a continuous process in the research community.

2. Approaches in machine learning

ML algorithms wide classification is done in three categories which are supervised, unsupervised, and reinforcement learning as shown Fig. 2.

A Supervised Learning uses an algorithm that requires external help. The provided input database is separated into training and testing datasets. The output variable is predicted or classified from the training database. Algorithms try to learn some shapes during training the database and implement these learned patterns to the testing database which provides results in estimation [4].

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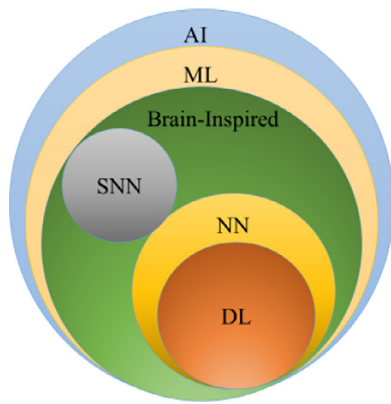


Fig. 1. Shows the correlation between artificial intelligence (AI), machine learning (ML), and deep learning (DL) [34].

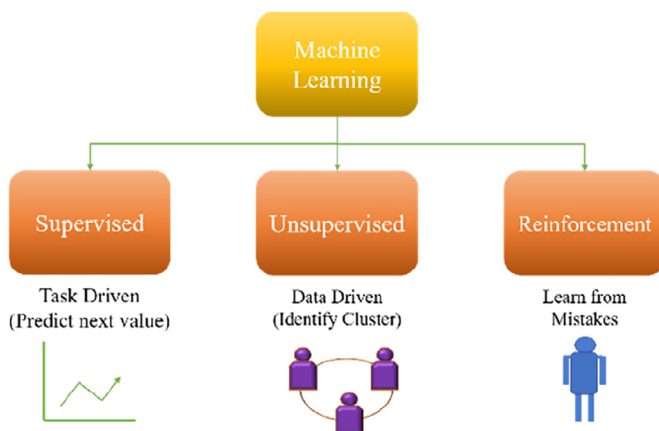


Fig. 2. Machine learning approaches [4].

- B Unsupervised learning is a machine learning algorithm that learns some characteristics of input information. After providing a new database, it utilizes formerly learned characteristics for the identification of the class of data. It is mostly preferred for feature reduction also for clustering.
- C Reinforcement learning is action based on decision concept learning. In this learning, actions are based as per the decision taken so that the results become more valuable at the output or desired favourable condition. However, the learner doesn't have prior information of data. After providing the situation, it learns to decide which action to be taken according to the given situation. The present and future situation is affected by the learner's decision i.e. action taken. Reinforcement learning exclusively relies on two conditions: delayed outcome and trial and error search [5].

3. Machine learning overview

The evolution of machine was done by Arthur Samuel in 1959 who introduced the term machine learning, a pioneer in the area of AI, computer gaming. Before that, foremost chess game based on the computer program with paper and pencil was created in 1948 by Turing and Champernowne. Then, in 1951 Dietrich Prinz's new chess game machine was introduced. In 1952, Christopher Strachey created the foremost draughts algorithm. The entire draught session was played at a good speed. In the 1960s, Nilsson published a book on machine learning with pattern classification. In 1970, Duda and Hart explained that interest in pattern classification continued. Further, in 1981 from the computer terminal neural network began to learn 40 characters. In 1985 and 1986 neural network scientists Hinton, Nielsen, Rumelhart, Williams-

Hetch, consecutively shown the idea which is the multilayer perceptron (MLP) with practical backpropagation (BP) training. As coming towards today's time, a new era of neural network that is termed as deep learning had grown. The third next rise of the neural network had begun in the year 2005 with researchers Andrew Ng, Hinton, Bengio, LeCun, and various other researchers.

3.1. Machine learning applications

The literature has shown several application fields, sub-fields with machine learning. The real-world applications are listed below and shown in Fig. 3

Computer vision is a versatile domain of machine learning which trains the machines for processing, analysing, and recognizing visual data. The various key algorithm in computer vision is KNN, SVM, Naïve Bayes. The sub-domains of this field are object detection, object processing, recognition.

Today because of the COVID-19 pandemic, new era technologies such as facial recognition and iris scans are at topmost demand as fingerprints authentication is not in line along with distance norms. For Aadhar cards in India and Banks, this face recognition with ML will be beneficial.

Machine learning-based face recognition technology is used to recognize extremists in the crowded places from the visitors at congress centres, airports, and various other important events. Now at the pandemic situation of COVID-19, this technology is proving very helpful in contactless communication and security. Thus, currently used in many businesses. Also, computer vision is used in face recognition for security purposes. An algorithm recognizes the faces of the person then allow permission for further accessibility. Moreover, used for automatic attendance system checking in professional institutes. That provides ease over the conventional methods such as keys, identity cards which can be easily stolen. Pardo, F. 2020 [6] introduces a deep reinforcement learning library called Tonic for further fast implementations in research. Various other applications such as FacePRO, Waymo are used for facial recognition and car safely driving apps respectively.

Handwritten recognition application makes the work easy for organizations where handwritten documents are large. For example, universities, exam centres, police, etc. It is a process of scanning and digitizing documents in a few minutes.

Speech recognition is a process of translating spoken words to text. It is providing benefits to healthcare, military, in cars systems or to create voice interfaces and voice assistants in everyday life as it helps to improve accessibility. Speech recognition is also known as speech to text and automatic speech recognition. Various algorithms used are artificial neural networks, vector quantization, dynamic time wrapping. Wibowo, H. et al 2020 [7] provides the forward-translation of Indonesian informal to formal language with semi-supervised learning and shown the improvement in results.

With research, special software can detect any variance in humans accurately in the healthcare department. It can detect various parameters at the same time and process them for medical records in real-time applications. Also, statistical analysis of medical documentation is proving itself a great benchmark.

Predictions based on historical data can be done using machine learning. Various applications like stock pricing predictions, scientific research, marketing campaigns, and many more cases. Generally, artificial neural networks and random forest algorithms are used for predictions. Its various sub-domains are text classification, image classification, medical diagnosis, etc.

One of the beneficial domains in machine learning is the bank sector and financial sector where the chances are high for fraud detection in case money transactions are going digital. Fraud detection and prevention are done based on the identification of patterns in client transactions, identifying strange behaviour, credit scores. Mostly, classification and regression techniques of machine learning as well as neural net-

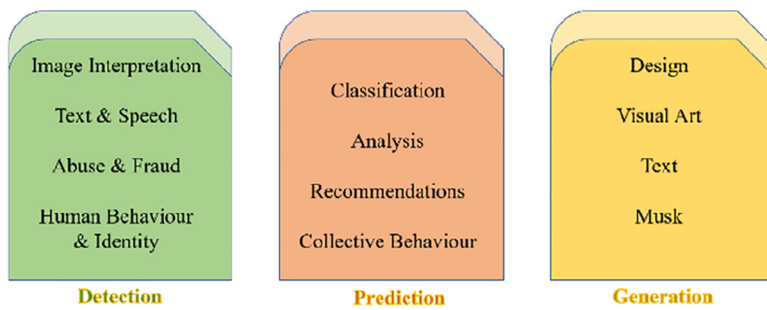


Fig. 3. Applications of machine learning and deep learning.

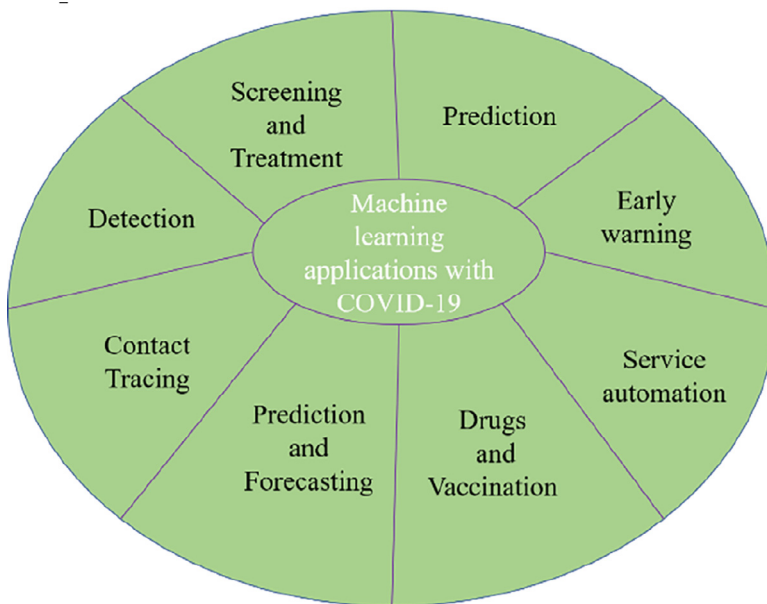


Fig. 4. Machine learning applications with COVID-19.

works are used in scam detection. Auto encoders technique with Tensor flow and Keras are being established for the detection of credit card frauds that saves a huge amount of money for cost recoveries and insurance for financial institutions.

3.2. For COVID-19 applications of machine learning

Diagnosing patients, identifying who is at most risk, better understand viruses, predict the spread of the disease, Map from where the viruses come, discovering existing drugs that can help, developing drugs at the fastest speed, Predicting the next pandemic is the crucial task done by machine learning shown in Fig. 4.

Machine learning is used for infection prediction in COVID-19. This virus spread worldwide very rapidly which needs international actions. Therefore, ML can be used to predict the behaviours of new cases to stop the disease from spreading as machine learning train the machines with mathematical models for learning and analysing. After training the machine, an interesting pattern can be detected. Researcher's Li et al. [8] developed a prediction model with machine learning to detect the reported cases in china and the world and Kumar et al. [9] applied the ARIMA (autoregressive integrated moving average) model to predict the coronavirus spread in 15 most infected countries. Huang et al. [10] used CNN and proved the CNN model efficient when compared with the model MLP, LSTM, and gated recurrent units. Pandey et al. [11] applied two statistical algorithms— regression models and the susceptible-exposed-infectious-recovered (SEIR) for evaluating and forecasting the distribution of COVID-19 in India.

Machine learning is an unbelievable sub-domain of AI, and its involvement in the development of technologies is precious and contin-

uous. It has created many beneficial applications in various fields and made many developments simpler where it is included.

4. Review on deep learning

Deep neural networks, a subcategory of machine learning. It is a network model with neurons having several parameters and layers in between input and output. DL follows the neural network architectures approach. Thus, called deep neural networks. DL provides automatic learning of features and their representation in a hierarchical manner at various levels. This powerful process of deep learning makes it robust in contradiction of traditional machine learning methods, in short, deep learning complete architecture is used for feature extraction and alteration process. The initial layers perform simple processing of input data or learn the easy features and that output goes to the upper layers which performs complex features learning. Therefore, deep learning is suitable for dealing with larger data and complexity [12].

4.1. History

McCulloch & Pitts (1943) demonstrated the Turing machine constructed from joining the neurons [13]. In 1958, Rosenblatt [14] showed that the perceptron's would intersect if what they were seeking to learn was able to be represented. Minsky & Papert in 1969 [15] had presented the drawback of perceptron's, cease the investigate in neurons working for at least a decade. After that Geoffrey Hinton et al. (1985) [16] introduced the back-propagation algorithm. Then a hierarchical neural network in 1988 called Neocognitron [17] was skilled for visual pattern recognition. Further, Yan LeCun in 1998 [18] analysed back propaga-

tion with CNN for document analysis. Then, the Hinton laboratory in 2006 solved the training issue for DNNs [19,20]. From 2012 till now 2020 a deep learning algorithm is increasingly developing in various domains.

The need to use DL

Presently, DL is applied in almost all fields. Thus, this method is frequently termed as a universal learning method. DL is being used in numerous situations where machine intelligence can be beneficial such as navigation on Mars where there is the absence of a human expert, vision, speech recognition, and language understanding and biometrics, personalization for solutions in particular cases.

- A Universal learning method: The DL method is now occasionally termed as universal learning as it is proving itself a useful technique to almost every application field.
- B Robust deep learning methods do not need a precise designing feature. Instead, its process of automatically learning and representing the best features for any task make it robust.
- C The deep learning approach is generalized that means the same DL method can be applied with different types of datasets or in different applications. That method is also termed as transfer learning. Moreover, this method is supportive where the problem has insufficient data.
- D The DL method is extremely scalable in terms of data and computation. Microsoft created a deep network called ResNet [21] and was implemented at a supercomputing scale.

Along with that, there are plenty of challenges in DL such as Big data analytics with DL. A survey in this context was conducted by [22] author of the paper explained the various principles like velocity, volume, and veracity of big data and also describe the merits of DL with big data [23,24]. Scalability in DL methods, the capability to produce data that is significant where adequate information is not accessible for learning the system e.g. in inverse graphics, a computer vision task, mobile intelligence which are energy-efficient techniques, FPGAs, and many more, deals with causal learning.

All the above discussed challenges are faced by DL researchers until now. The performance of traditional ML methods had presented better performance with a minimum intake of data. After crossing the threshold point, traditional machine learning methods performance becomes stable, on the contrary, DL methods performance increases with increasing the amount of data.

The key motives in the acceptance of deep learning nowadays are because of enlarged chip processing capabilities such as GPU units, cost-effective computer hardware, and create current advancements in machine learning projects [25]. GPU speed up the research as the high-speed evaluation is required in deep learning because of the large volume of data. With a larger dataset, speed increment is also required which shifts the GPU to TPU (Tensor processing unit) and then HPC which high-performance computing/supercomputing, where HPC takes care of both computational improvements in terms of hardware and software that will scale up deep learning.

In GPU each set of weights can be stored as a matrix (m, n). GPUs are beneficial to perform common problems parallelly problems faster. Also, all alike calculations can be at the same time. This enormously boosts the performance in parallel computations.

Various companies due to the COVID-19 blues adopting new era technologies investing hugely in ML, DL techniques to make a better prediction, analysis, and communication with customers. For example, American express sets an AI, DL lab in IIT Madras, Prato a medical app that uses artificial intelligence, financial sector, new-age security systems, and leveraging many businesses and creating with new normal COVID-19 time. Because many enterprises viewing artificial intelligence as a planned opportunity.

4.2. Deep learning applications

In Big data, MAVIS-Microsoft speech recognition is done with the help of deep learning. In this learning human voices and speeches help the search of audios and video files. [26] Also, Google applied the deep learning method on the Big data environment for image searching which helps to create an understanding of images so that image tagging, indexing, and annotation can be made easy. A deep dream is Google's software that can classify the images and can generate artificial and strange paintings from its knowledge. Further, deep text announced by Facebook is also an artificial intelligence arrangement. In this machine understand the text with a deep learning-based technique that can classify large data, also various corresponding services such as cleaning up spam messages and identifying handlers chatting messages.

Nowadays Google maps are using DeepMind artificial intelligence to predict arrival time and this technology is adopted by PSUs for cyber-security with the outbreak of new normal COVID-19 blues. Beattie, C. et al. 2020 [27] presented DeepMind Lab2D, a simulator which provides a scalable environment for artificial intelligence research.

Google in collaboration with Improbable company recreates the real-world with augmented reality (AR). For example, an improved navigation system uses AR to superimpose the route over the live view of the roadway, AR glasses are used by Singapore airport ground staff to see more information regarding cargo containers and speed up load times.

The biggest challenge for the future nation and parents to detect and handle developmental delay in children. Researchers at MIT had established a computer system that is capable of identifying language as well as speech disorders even before kindergarten.

Autism, developmental disorders, and speech disorders are a barrier to a children quality full life. Initial stage analysis and its cure can generate a brilliant outcome such as physical, emotional, and mental health.

Photo Descriptions has used deep learning methods amazingly. Andrej Karpathy and Li Fei-Fei worked on deep neural network training to recognize lots of exciting zones in the image than writing a sentence that elaborates each portion of the image. Computers tend to automatically classify photographs. For example, Facebook and Google Photos. Wan, Z. et al. 2020 [28] have shown critical degraded old photos restoration via deep learning approach.

Pixel Restoration or Pixel Recursive Super-Resolution with deep learning made possible the zooming concept in videos. Researcher Google Brain in 2017, a deep learning network was trained with extremely low-resolution face images then predict the individual's face through it.

The recurrent neural network with CNN and LSTM generating sounds to silent movies or videos. The video frames are synchronized with a dataset of pre-recorded sounds to do a choice for the appropriate sounds for a particular scene. Thus, it tells whether the sound is real or fake also for good results a Turing-test setup created. Zou, Z. 2020 [29] present a sky replacement dynamically and videos harmonization with deep learning.

Complexities of language are difficult to understand whether it is syntax, tonal nuances, semantics, expressions, which are the toughest tasks for a human being to learn. With the help of deep learning, Natural language processing (NLP) is trying to achieve the optimal level of success. SVM, logistic regression was time-consuming but now CNN, RNN, reinforcement learning has achieved a significant level of results. Ramamurthy, R. et al. 2020 [30] provides a new toolkit for the evaluation of reinforcement learning on NLP tasks.

Self-Driving Cars are new with artificial intelligence. The AI lab of Uber is working on creating driverless cars with several smart features. As per Forbes, MIT is trying to develop a system that will permit navigation of independent cars without a map. The restriction is still present for 3-D mapping at some prime zones in the world as it is not effective to avoid accidents. Zhou, M. et al. 2020 [31] develop open-source SMARTS which is "scalable multi-agent reinforcement learning training

school for autonomous driving” that helps in training, how to utilize diverse behaviour model of road users, accumulation.

4.3. Applications with COVID-19 for deep learning

Deep learning is used for X-ray diagnosis to study the affected area of the body as cancers, bone problems, injuries, and lung diseases. [32,33], CNN based models ResNet-50, Inception-v3, and Inception-ResNet-v2 used to predict COVID-19 patients with chest X-ray images by Narin et al. [32] and reported that ResNet-50 had the best detection accuracy (98%). Further, a deep learning algorithm and support vector machine (SVM) is used to categorize the image as healthy or infected by the feature extraction process with chest X-ray images. Various deep learning models like Inception-v3, AlexNet, VGG16, Inception-ResNet-v2, VGG19, ResNet-18, ResNet-50, GoogLeNet, ResNet-101, DenseNet201, and XceptionNet were used and achieved a 95.38% accuracy with ResNet50 and SVM. Godfrey Hounsfield and Allan Cormack in 1972 developed a CT Scan. The CT scan diagnosis with deep learning uses X-ray technology to carefully diagnose delicate internal organs [30,34]. Waheed, A. et al. 2020 [35] presents a CovidGAN for improved covid-19 detection.

5. Discussion

Various applications such as computer vision, natural language processing, semantic analysis, prediction fields with machine learning, and deep learning methods. ECRM (electronic customer relationship management) the newest filed as an application of deep learning. The main aim of using deep learning is GPU (Graphics Processing Unit) hardware, data dependencies, and feature engineering. Data dependencies means which works with a large amount of data. The distinguishing point of DL in comparison to ML is its capability to acquire high-level characteristics from given data called as feature engineering. Thus, deep learning is emerging with new applications in several areas in the future. It is said by Andrew Ng in his Quora post “There’re many projects in precision agriculture, consumer finance, medicine, where deep learning has a great impact and grows rapidly.

6. Conclusion

Machine learning practices with a set of algorithms to analyse and interpret data, learn from it, and based on that learnings, makes the best possible decisions. In the case of deep learning, the system depends upon layers of artificial neural networks. The in-depth study of deep learning and machine learning with its applications are discussed. Nowadays every individual is doing utilization of machine learning directly or indirectly. From receiving recommendations on a product in electronic shopping to update the pictures on social network sites. The development of both machine learning and deep learning, their key features, common features, and difference are also elaborated. That tells us that there is a new scope of deep learning with various applications that can produce remarkable results in the future. As research is a continuous process, a new architecture may also evolve.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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