Acta Scientific AGRICULTURE (ISSN: 2581-365X)

Volume 5 Issue 9 September 2021

Review Article

Emerging Trends of Artificial Intelligence in Agriculture

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Received: July 19, 2021

Published: August 24, 2021

Abstract

This article outlines and examines the meaning, benefits of Artificial intelligence (AI) in predicting its benefits in Agriculture through machine learning. While Artificial intelligence is the capacity of the system to grasp, comprehend, analyze and predict data, Machine learning Creates models through natural language programming (NLP) and facilitates the prediction. This process requires big data base. Data is the fundamental basis of AI. Instead of manually cultivating, AI through algorithm facilitates automatic search agricultural processes are feed to the system through machine learning model. The easy methods of farming will be ascertained and used for agriculture.

In many countries AI is being used to predict data and to decide whether This is facilitated by AI through predictions referring to the data to understand a particular agricultural process is suitable for a land, what type of farming , labor are required are analysis . Therefore, it can be said that AI does the work of a human being though training in the form of program. The author is interested to bring to light the use of AI in Agriculture, its benefits to the farmers with relevant examples and its disadvantages with conclusion and suggestions for effective use of AI in this regard.

Keywords: Artificial Intelligence; Machine Learning; Algorithm; Supervised Learning; Unsupervised Learning

Introduction

Artificial intelligence (AI) is the capability and ability of a computer program or a machine to comprehend information, and to think, learn and grasp. It may also be said to be a specific field of enterprise that strives to design 'smart' computers. These machines toil unaided do not need encoding with commands. Machine learning (ML) is a subgroup of AI. It is an application of AI providing machines the capacity to independently grasp and better them out of experience, with no need to program them expressly. ML has been in use in several industries and domains. For e.g. image processing, classification, regression, medical diagnoses, prediction, learning association, etc.

The original name of ML used to be statistical learning theory. Computational statistics, focusing on prediction-making utilising systems, is a subcategory of machine learning and is closely related thereto; but all machine learning is not statistical learning. The theory, methods and application domains are fostered upon the sphere of ML by studying mathematical optimisation. A related field of study is data mining which focuses on investigative and probing data scrutiny by utilising unsupervised learning [1]. ML is also called predictive analytics when it is applied to solving myriad business problems. ML instructs the system how to do, instead of telling what to do [2]. Thus, the system utilises this competence to resolve other problems faced by it without the aid of express programming. ML has been constructed on the field of Com-

puter Science and Mathematics. ML techniques are aptly expressed utilising matrix and linear algebra and ML behaviours are suitably appreciated utilising the tools of statistics and probability.

Definitions

Machine learning (ML) is the study of computer algorithms that improve automatically through experience [3]. An often quoted, more conventional definition of the algorithms studied in ML learning sphere was provided by Tom M. Mitchell: "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E" [4].

ML is a process of information analysis leveraging ML algorithms in order to grasp it relatively from existing information and aid systems in finding concealed insights without the need of programming. ML algorithms construct a model basing on test-data, called 'training data', so that predictions or decisions can be made without the aid of express programming.

Machine learning - goals - creating expert systems

ML fosters on machines the ability of displaying clever and self-operating conduct; and the ability of grasping, displaying, clarifying, etc. ML aims at making the machines proficient in giving the end-users the finest results. These machines must be able to change their activity in reply to changing situations and past events.

Application of intelligence in machines

The purpose is developing machines having the ability of comprehending, grasping, deliberating, mastering, assimilating information, and conducting themselves like humans.

Importance of machine learning

The iterative aspect of ML is its core technique and is of significance. Models are able to independently adapt as they are exposed to new data. They grasp from earlier calculations, thereby producing dependable, repeatable choices and outcomes. ML is a science gaining renewed impulse. This is due to causes like cheaper computational processing, data storage capabilities that are more powerful and affordable, available data which is growing both in terms of volume and varieties. These causes result in automatic and quick producing of models which are capable of analysing greater, and more complicated information, and extend more precise outcomes, even on a very great scale. Thus, by constructing accurate models, an enterprise has greater chances to identify opportunities that are profitable or steering clear of unknown risks. Iterative learning is in focus here. Over time, systems tend to adapt to new information that they get exposed to.

The systems start learning to repeat choices made earlier in same circumstances, basing on the choices on the calculations and patterns earlier created. The ability of the systems to learn from the earlier patterns is now becoming very popular.

History of machine learning

Arthur Samuel, an American IBM employee and a pioneer in the study of AI and computer gaming first coined the term "Machine Learning" in 1959 [5,6]. Nilsson's book on Learning Machines was a representative book of ML research during 1960s. It mostly dealt with ML for pattern classification [7]. Interest in pattern recognition carried on into the 1970s, as elaborated by Duda and Hart in 1973 [8]. A report was given in 1981 on utilising teaching techniques in order that a neural network comprehends to recognise 40 characters (26 letters, 10 digits, and 4 special symbols) from a computer terminal [9].

The working of machine learning

Farmers, in order to get maximum benefit from AI, are bound to construct ML models basing them on iterative learning techniques. Must know the art of pairing the exact algorithm with the right tool or process. Some important ML algorithms include, (1) Random forests, (2) Decision trees, (3) Boosting and bagging gradient, (4) SEO, (5) Analysis of principal components, (6) Mapping of nearest neighbour, (7) Neural networks, (8) Self-organizing maps, (9) Discovery of sequence and associations, (10) Multivariate adaptive regression, (11) Supporting vector machines, etc.

The pertinent tools and processes include, (1) Easy model deployment to get speedy, dependable and repeatable results, (2) Identification of best performers through automated ensemble model evaluation, (3) Overall data quality and management, (4) Comparing several ML models and identification of the finest among them, (5) Information investigation followed by visualization of model outcomes, (6) Automated information-to-choice process, (7) Development of graphical user interface for building models and creation of process flows.

Machine learning - applications

The ML technology is of paramount value to companies spanning several industries dealing with vast amounts of information

and data. Companies leverage inputs obtained from this information to perform in an efficient way by controlling costs and getting an edge over competitors. The implementation of ML, finding expression in various applications includes, Marketing and Sales, Government institutions, Financial Services, Healthcare, Oil and Gas Industry, Transportation, Defence, E-Commerce, etc.

Machines are now being able to conduct application of complex mathematical computations to fields, such as vast amounts of data, at a high speed. For e.g. Google Car is primarily designed on the essence of ML. Another example of ML in everyday life is frequent recommendations given by organisations like Amazon and Netflix. ML can be integrated with creation of linguistic rules with much benefit. Twitter has implemented this application, where one can know what customers are saying about a business. ML is extensively being utilised for detection of fraud in several industry sectors.

Popular approaches of machine learning methods

Though supervised and unsupervised learning are most widely accepted ML techniques by businesses, there are several other ML techniques. Some most accepted ML methods are as follows.

Supervised learning

Labeled examples are used for training these algorithms in different scenarios. Labels are used as an input where the desired result is already known. A set of input instructions along with corresponding precise results are given to a learning algorithm. A comparison of the actual result with the precise result will then be made by the learning algorithm, which will flag an error, if there is any discrepancy. Supervised learning utilizes several patterns to proactively predict values of a label on other unlabeled data, using several techniques like classification, prediction, regression, and gradient boosting. This technique is mostly utilized in fields wherein past information is used to predict future incidents. For e.g. for predicting which insurance customers are going to file claims or in anticipating when a credit card transaction fraud is likely to occur.

Unsupervised learning

This method of ML is applied in fields wherein information has no past labels. Here, the algorithm must identify what is shown and the machines will not be provided with the 'right answer'. The main purpose is to analyze the information and identification of a pattern and structure from among the available data set. A good source of data set for unsupervised learning is transactional data. This method of learning helps in identification of customer segments with similar attributes, and then lets the business treat them similarly in marketing campaigns. Some of the widely used techniques of unsupervised learning are: (1) value decomposition, (2) k-means clustering, (3) mapping of nearest neighbor, and (4) self-organizing maps.

Semi-supervised learning

The application of this type of learning finds expression in the same kind of situations where supervised learning is applicable. This method utilizes both unlabeled and labeled data for training. It is often used with methods, such as classification, regression, and prediction. Semi-supervised learning is utilized by companies unable to bear the high costs of labeled training process.

Reinforcement learning

This is often utilized in robotics, navigation, and gaming. Algorithms utilize trial and error methods for identification of actions that yield best rewards. The agent, the actions and the environment are the major parts in reinforcement learning. The agent is the decision maker, the actions are activities done by the agent, and the environment is what an agent interacts with. The purpose is to choose the activities that optimize the reward, within a particular time. The agent can attain the goal speedily by undertaking a good policy. Thus, the main aim of reinforcement learning is the identification of the best policy or method that assists organizations in attaining the goals with more speed. ML can develop thousands of models in a week. On the other hand, humans are capable of creating only a few good models a week.

Development of other approaches has been undertaken which do not fit neatly into the above three-fold categorisation. At times, multiple approaches are employed by the same ML system. For e.g. dimensionality reduction, topic modelling, or Meta learning [10]. Deep learning is becoming the prime approach, as of 2020, for most of the continuing activity in the sphere of ML [11].

AI and agriculture

Usually called as Agriculture Intelligence is doing agriculture with the use of technology – artificial intelligence through machine learning, where by data is fed to the computer, and the computer will process the data through Algorithms and gives the required

result. Automation facilitates revolution in the future of forming. Drones, satellite imagery. Robot for example Harvest CROO Robotics are useful for farming. It also facilitates ploughing, Harvesting and cutting of crop with less cost and labour in real time. Mobilization of such machines is also easy. And have commercial value. A team of Engineers have prepared machines for agricultural use which work through AI.

Blue River technology is useful for spreading fertilizers in the field and Identify and eradicate weeds. This is done by a camera which worked through on board computer fixed in the back of the tractor. While the tractor is operated in the field, camera works through deep learning algorithms to identify weeds and sprays pesticides if necessary. These devices are efficient, with less wastage and will result in a safer produce.

Forecasting weather so that the time of harvesting and cutting of crops and be well decided in advance e so that loss will be minimized do to fluctuating weather conditions. Such conditions may be temperature, Rain Humidity and Solar Radiations. Ai can be used to get data from all these technology to predict the results in advance and get better results.

Advantages of machine learning

Improves Accuracy of Financial Rules and Models is improved through ML. Efficiency of Predictive Maintenance in Agriculture is enhanced. Time-Intensive Documentation in Data Entry is simplified. ML also assists in Precision Sales Forecasts through, (a) Interpretation of Past Customer Behaviors, (b) Consumption of Massive Data from Unlimited Sources, (c) Rapid Analysis Prediction and Processing. Precision Lifetime Value Prediction and Better Customer Segmentation are facilitated. Recommending the Right Product, for any sales and marketing strategy, product recommendation is a crucial aspect. Purchase history of a customer is analyzed by ML models and on this basis, the ML models identify those products from the product inventory which interests a customer. The hidden patterns in items are identified by the algorithm, which thereafter, creates groups of clusters consisting of similar products. This process is an example of unsupervised learning. Such a model enables organizations in making better product recommendations to their customers, thus encouraging purchase of products. Thus, unsupervised learning is instrumental in generating a superior product-based recommendation system.

Microsoft Azure, Amazon and Google have launched their Cloud ML platforms. Easy Spam Detection - 'Spam' detection by a person's email provider. 'Image' or 'Face' tagging is being done by Facebook. Gmail recognizes picked words or pattern to filter out spam. On the other hand, automatic tagging of uploaded images using image (face) recognition technique is done by Facebook. Drones facilitate sowing seeds, and other agricultural process.

Disadvantages of machine learning

ML cannot be improved with experience, as humans can. This is due to the fact that systems cannot change their reactions to varying circumstances. ML completely lacks in genuine creativity and originality in thinking. These are the attributes of a human mind. Thus, ML can come nowhere near to the instinctive and intuitive abilities of a human mind. ML cannot replicate the qualities of a human mind.

If ML falls into the wrong hands, mass destruction and annihilation may be the result. This can be disastrous for the future of mankind. Also, there is a constant danger of machines taking authority over humans and overriding them. Enormous costs have to be frequently incurred over creation, updating and maintenance of ML programs. Software programs are in constant need of up-gradation at frequent intervals, involving high maintenance cost.

Large-scale unemployment will be caused if systems replace humans, leading to treacherous and vicious utilisation of their impatient and imaginative minds by the humans. This will make them lazy and result in the loss of their creative faculty. These systems do not possess the judgment of right and wrong, and are bereft of moral values. Apart from this, they are not capable of making choices unfamiliar to them and for which explicit programming is not done for them.

Legal issues involved in the implementation of machine learning

If ML is not properly regulated, drastic implications will follow, and it will become counter-productive. For e.g. when a robot is undertaking a surgery, sudden stoppage of electricity may cut off access to a doctor. Other countries have dealt with these issues, but in India no legal framework exists to combat such situations. Thus, all countries need to equip themselves with stringent legislation to overcome such threats from imprudent and possibly damaging and harmful ML technology.

Challenges of machine learning

Though many developments have taken place the world over, there is an absence of fool-proof legislation for the structuring and regulation of this expanding field of study in India. There is no specific enactment related to AI or ML.

Fixing of responsibility

The decisions being taken by ML-powered devices are becoming increasingly divorced from any direct programming, and are based more on ML principles. Due to this, it is more difficult to assign or fix responsibility or fault to a particular person. With regard to accidents involving AI and ML, it is difficult to tell as to who is at fault. A machine that cannot answer for its own actions cannot be blamed. In such situations, it will be difficult for the Court whether to blame the manufacturer, the team monitoring the car, or the programmer. Thus, it is very hard to determine the culprit, as there are no proper laws to fix responsibility. Traceable defects, i.e., system choices which are traceable back to defective operation or incorrect programming, are comfortably dealt with by the existing liability frameworks. However, legal frameworks start to collapse where faults are not explainable or unaccountable, or are not traceable to human error.

Systems being more artificial than being intelligent

A machine in use across United States was used for identification of future criminals. It was found later that it was biased towards African-American people. In this situation, it is clear that the artificial outweighs intelligence. A person who does not have knowledge about coding would come to think that the team involved were racist. In such cases, passing of judgment by Judges is rendered difficult.

Data privacy

If one has access to millions and millions of data points, it becomes a colossal task to protect them. In case the algorithm is based on sensitive or confidential data, it will become very difficult to make sure that this data is useful for the product, and at the same time also protects the owners of the said data. In the race for business supremacy, privacy will be the causality.

Lack of privacy

ML has the capability to predict music preferences, shopping preferences and the location of a person at a certain time. The probability of a person being a criminal can also be predicted by ML. All this is done by means of shared information. In such situations, privacy is almost zero. It is highly doubtful whether such information will be admissible in Court, by virtue of the fact that most of the information is procured by a system trailing a person's behaviours.

Contracts and liability thereupon

A company cannot possibly assume entire risks with regard to its products, more so, if the products are unpredictable ones. In such circumstances, it becomes increasingly difficult to draft contracts which are fair between clients, the company and ultimately, the users.

Intellectual property

ML algorithms are exceedingly collaborative. Prior research and development goes into their coding. There are many issues arising out of the above conditions, such as, (1) how to bring about and increase collaboration amidst industry and academia, (2) How one can push for collective good, while creating Intellectual Property Rights and value, (3) How to balance the competing concerns of market advantages and public good.

Human rights

The result coming from the algorithm will be completely flawed and faulty, if the dataset is biased at the very inception. Thereby certain populations/groups will be greatly disadvantaged, entailing dangerous repercussions for the individuals and the business organisation.

Suggestions to evolve beneficial and constructive machine learning

It is necessary to establish the legal personality of AI and ML, and the question of attributing any intention to it. Mens rea or intention is an indispensable component of criminal law jurisprudence in India. This means that a bunch of rights and duties will be possessed by AI and ML. The regulatory regime should structure a mechanism for distinguishing between error of judgment (where one is innocent) and error of intent (where there is mens rea), whereby innovation may be encouraged. Otherwise, the fear of punishment will take the edge out of innovation in ML.

Review of existing laws is essential in order to keep up with advances in the field of ML and its diverse applications. Special

legislations relating to AI and ML must be enacted. There must be an introduction of a strict liability system. This must be backed b a licensing fund and a certification agency. Its working would b through the introduction of an assessment system for a robotic c ML device. The release of this device into the open market woul entail payment of a levy. The levy would serve as a contribution to a fund. In the event of a risk, this would enable the pay-out c compensation. Higher licensing charges would have to be charge for funding larger variety of risks, as systems begin to be increas ingly capable.

It is the need of the hour to undertake more in-depth researcn and study of ML, and also to study and identify the risks due to MI in order to stem the damage that may be wrought by its imprudent usage.

For countering cyber-attacks and avoidance of errors in prc gramming, the quality of ML software is to be taken care of by the technology industry. Vigilant and committed research is essentia There is need to bridge the gap between academia and industry in India with regard to ML, by devising more stringent policies an ' implementing them sincerely. Poverty can be alleviated by benefi- cial and advantageous utilisation of ML.

Conclusion

The way the business of life is conducted will change dramat cally in the near future due to far-reaching changes and develop ment in ML and AI. ML does the work of unshackling and elevatin human intellect. Human tasks are increasingly taken care of by ML systems. Consequently, much of the brain is left free and withou strain. This leads to unfettered and free thinking, and novel way of creativity. But ML also has its disadvantages. It is the bounden duty of humanity to ensure that it is not ruled by the very servar it created. ML will shower blessings upon civilisation as long as it is kept beneficial.

Developing ML to its maximum potential sounds great. But it gives rise to several issues that may generate problems for humans instead of solving them. The development of ML should be under- taken to make life easy. It should not lead to replacing life itself. This way most issues will be solved. Therefore, it can be concluded that smart farming is useful in a long run through AI, provided the disadvantages associated with AI be overcome effectively and ef- ficiently.

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