

Applications of Artificial Intelligence in Machine Learning: Review and Prospect

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ABSTRACT

Artificial intelligence(AI) is a combination of computer science, physiology, philosophy with mathematics and several other disciplines. AI and its applications is a very important aspect of computer and science revolution. As the world is fast globalizing, the hope for AI machines to take up human mental and physical capacity is rising, as it is believed will relieve menial works and duties that pose risk to life. In this paper, a brief review and future prospect of the vast applications of artificial intelligence in machine learning has been made.

KEYWORDS

Artificial Intelligence, Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement learning algorithms.

1. INTRODUCTION

The ultimate goal of AI is to develop human like intelligence in machines. However, such a dream can be accomplished through learning algorithms which try to mimic how the human brain learns. Machine learning, which is a field that has grown out of the field of Artificial Intelligence, is of utmost importance as it enables the machines to gain human like intelligence without explicit programming. However, AI programs do the more interesting things such as web search or photo tagging or email anti-spam. So, machine learning was developed as a new capability for computers and today it touches many segments of industry and basic science.

In the area of machine learning research, more emphasis is given to choosing or developing an algorithm and conducting experiments on the basis of algorithms. Such highly biased view reduces the impact on real world applications.

In this paper the various applications under the appropriate category of machine learning has been highlighted. This paper makes an effort to bring all the major areas of applications under one umbrella and present a more general and realistic view of the real world applications.

Apart from this, two application suggestions have been presented forward. The field of machine learning is so vast and ever growing that it provides to be useful in automating every facet of life.

2. MACHINE LEARNING

Machine learning is an application of artificial intelligence that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves.

According to Arthur Samuel, machine learning is defined as the field of study that gives computers the ability to learn without being explicitly programmed. Arthur Samuel was famous for his checkers playing program. Initially when he developed the checkers playing program, Arthur was better than the program. But over time, the checkers playing program learnt what the good and bad board positions were, by playing many games against itself.

A more formal definition was given by Tom Mitchell as, "A computer program is said to learn from Experience(E) with respect to some Task(T) and some performance measure(P), if it's performance on Tas measured by P improves with experience (E), then the program is called a machine learning program."

In the checkers playing example, the experience E, was the experience of having the program playing games against itself. The task T was the task of playing checkers and the performance measure P was the probability that it won the next game of checkers against some new opponent. In all fields of engineering, there are larger and larger datasets that are being understood using learning algorithms.

3. Types of Machine Learning Methods

3.1 Supervised Machine Learning Algorithms

They can apply what has been learnt in the past, to new data using labeled examples to predict future events. Starting from the analysis of a known training data set, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

3.2 Unsupervised Machine Learning Algorithms

They are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabelled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from the data sets to describe hidden structure from unlabelled data.

3.3 Semi Supervised Machine Learning Algorithms

They fall somewhere in between supervised and unsupervised learning since they use both labeled and unlabelled data for training – typically a small amount of labeled data and a large amount of unlabelled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi supervised is chosen when the acquired labeled data requires skilled and relevant resources in order to train it/ learn from it. Otherwise, acquiring unlabelled data generally doesn't require additional resources.

3.4 Reinforcement Machine Learning Algorithms

This is a learning method that interacts with its environment by producing actions and discovers errors or rewards. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

4. INTEGRATION OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining Machine Learning with Artificial Intelligence and Cognitive Technologies can make it even more efficient in processing large volumes of information.

5. APPLICATIONS

5.1 Unsupervised Learning

In Machine Learning, the problem of unsupervised learning is that of trying to find hidden structure in unlabelled data. Since the examples given to the learner are unlabelled, there is no error or reward signal to evaluate a potential solution.

5.1.1 Analysis of gene expression data: Cancer diagnosis

Cancer can be defined as a class of diseases that is characterized without control of self growth. There are about 900 different types of cancer claiming the lives of innumerable people across the world. Thus, identifying the type of cancer is a crucial step in its treatment. It is done through classification of patient samples.

The classification process and results may be improved by analyzing the gene expression of the patient which may provide additional information to the doctors. The merger of medical science and technology has already led to a lot of life saving breakthroughs in the field of medicine[1].

5.1.2 Social Network Analysis

Unsupervised Machine Learning Algorithms can automatically identify the friends within a user circle in Facebook or Google or it can identify the maximum number of mails sent to a particular person and categorize into collective groups. It also identifies which are groups of people that all know each other[7].

5.1.3 Market Segmentation

Many companies have huge databases of customer information. So, unsupervised machine learning algorithms can look at this customer data set and automatically discover market segments and automatically group customers into different market segments so that the company can automatically and more efficiently sell or market the different market segments together. Again, this is unsupervised learning because it is known in advance what the market segments are, or which customer belongs to which segment[7].

5.1.4 Cocktail Party Problems

Consider a cocktail party with two people, where both are talking at the same time. Two microphones are placed in the room at two different distances from the speakers; each microphone records a different combination of these two speaker voices. These two microphone recorders are given to an unsupervised learning algorithm called the Cocktail Party Algorithm. The cocktail party Algorithm separates out these two audio sources that were being added or being summed together[9].

5.1.5 Medical Records

With the advent of automation, electronic medical records have become prevalent. So if medical records are turned into medical knowledge, diseases could be understood in a better way.

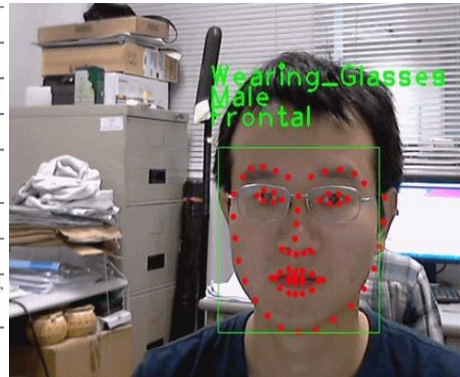
5.2 Supervised Learning

5.2.1 Pattern Recognition

It is the process of recognizing patterns by using machine learning algorithm. Pattern Recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation. One of the important aspects of pattern recognition is its application potential. In typical pattern recognition application, the raw data is processed and converted into a form that is amenable for a machine to use. Pattern recognition involves classification and clustering of patterns.

| Problem Domain | Application | Input Pattern | Pattern Class |
|-------------------------------|-------------------------------------------|---------------------------------|----------------------------------------------|
| Bioinformatics | Sequence Analysis | DNA/Protein sequence | Known type of genes/patterns |
| Data mining | Searching for meaningful patterns | Points in multi dimension space | Compact and well separated clusters |
| Document classification | Internet search | Text document | Semantic categories |
| Document image analysis | Reading machine for the blind | Document image | Alphanumeric characters / words |
| Industrial automation | Printed circuit board inspection | Intensity or range image | Defective / non defective nature of product |
| Multimedia database retrieval | Internet search | Video clip | Video genres e.g. action, dialogue etc |
| Biometric recognition | Personal identification | Face, iris & finger print | Authorized user for access control |
| Remote sensing | Forecasting crop yield | Multispectral image | Land use categories, growth pattern of crops |
| Speech recognition | Telephone directory enquiry with operator | Speech waveform | Spoken words |

(a)Pattern Recognition



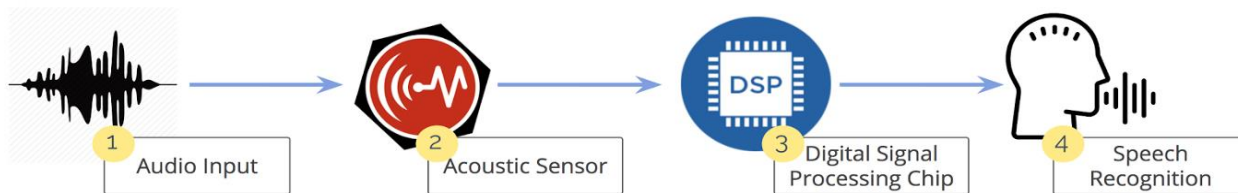
(b) Facial Recognition

5.2.2 Facial Recognition

Facial recognition is one of the common uses of machine learning. There are many situations for using facial recognition. As an example, high quality cameras in mobile devices have made facial recognition a viable option for authentication as well as identification. Apple’s iPhone X is one of its examples. Facial recognition application works in the software identifies 80 nodal points on a human face. Nodal points are end points used to measure variables of a person’s face, such as the length or width of the nose, the depth of the eye sockets and the shape of cheek bones [5].

5.2.3 Voice Recognition

Voice recognition or Speech recognition converts voice/speech into text. It is also known as Automatic Speech Recognition (ASR). Some examples are Google Assistant, Siri, Cortana and Alexa. Voice Recognition is one of the categories in Deep Learning.



The system analyses the human specific voice and uses it to fine-tune the recognition of that person’s speech, resulting in increased accuracy. Simple voice commands convert to decode and may be used to initiate phone calls, select radio stations or play music from a compatible smart phone, mp3 player or music loaded flash drive. Voice recognition software measures the unique biological factors, which form the users voice, from the sounds that a user makes while speaking[4].

5.2.4 Financial Services

Machine learning has a lot of potential in the finance and banking sectors. For example, Taaffeite Capital Management trades in a fully systematic and automated fashion using proprietary machine learning systems. In the finance world, stock trading is one of the most important activities. Stock market prediction is an act of trying to determine the future value of a stock other financial instrument traded on a financial exchange.

A Machine learning approach is trained from the available stocks data and gains intelligence. It then uses the acquired knowledge for an accurate prediction [2][3].

5.2.5 Health Care

The increasingly growing number of applications of machine learning in healthcare allows us to glimpse at a future where data, analysis, and innovation work hand in hand to help countless patients. One of the chief ML applications in healthcare is the identification and diagnosis of diseases and ailments which are otherwise considered hard to diagnose. Machine learning and deep learning are both responsible for the breakthrough technology called Computer Vision. Another sought after application of machine learning in healthcare is in the field of radiology.

5.2.6 Spam Filtering

It is mainly used to filter unsolicited bulk Email (UBE), junk mail, or unsolicited commercial email (UCE) from the emails. The spam filter saves the user from having to wade through tons of spam email, that's also a learning algorithm. The spam filter can also be learned by watching which emails you do or do not flag as spam. So in an email client if spam button is clicked to report some email as spam, but not other emails and based on which emails are marked as spam, the email program learns better how to filter spam email[6].

5.2.7 Information retrieval

Information retrieval(IR)is finding material of an unstructured nature that satisfies an information need from within large collections. The user provides an outline of their requirements- perhaps a list of keywords relating to the topic in question, or even an example document. The system searches the database for documents that are related to the user's query, and presents those that are more relevant. The IR process can be divided into four distinct phases: indexing, querying, comparison and feedback [8].

6. CONCLUSION

Humans have always sought to build a comfortable life, the proof of this lies in the fact that we have always depended on machines to get our work done more easily, in a faster more efficient manner. In the past machines have been used to reduce the manual labour required to the get a job done, but at present, with the advent of machine learning humans seek to build machines which are not only strong but also intelligent and hence machine learning has emerged to become an area of study that is ever in the bloom.

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