

# Machine learning and its applications: A Review

Ruchi Bansal<sup>a</sup>, Jagdeep Singh<sup>b</sup>, Ranjodh Kaur<sup>c</sup>

<sup>a</sup>Department of Information Technology, Baba Khajandas College of Engineering and Technology, Ludhiana.

<sup>b,c</sup>Department of Information Technology, Guru Nanak Dev Engineering College, Ludhiana.

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## Abstract:

Keywords :

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Methods

Application

Application Over the past few decades data is growing in abundance so there is a need to find something which can lead to important decisions and machine learning is helping a lot in this. It is a field of artificial intelligence which makes machine learn from the experience and examples just like humans do and find interesting patterns without being programmed. Data is given to the algorithm and model is built from it. Based on this model it can predict new values. It helps us to find something that is unknown and which can help us to explore many new things. Machine learning can be used in various fields like health, finance, retail, travel, media, image processing and computer vision, natural language processing, automated trading, automotive, aerospace, manufacturing and lot more. This paper provides a review on basics of machine learning, algorithms of machine learning and its applications in various fields.

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## 1. Introduction

Machine learning is the branch of computer science which helps computers learn without being explicitly programmed. [1] "A computer program is said to learn from experience E with some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E." -Tom M. Mitchell. Machine Learning is development of algorithms and techniques instead of programming for performing functions. [2] Machines learn from past examples and historical trends and based on their previous experience a model can be built which can be used for prediction of new values. It can be used

where data and questions are too large to be solved naturally, machine learning can help find answers to these questions based on the analysis of data. It can help people to search for important things in less time. Complex problems can be solved easily as machines learn faster and in some fields they can even excel humans. Due to this its demand is on the continuous rise. As big data and cloud computing is gaining importance so is the machine learning as it eases many problems with its computing power. It can be used in many applications. In health care it can help in drug discovery, allow doctors to make good diagnosis leading to prediction of many diseases in advance. In social media

it targets customers and segments them according to age, gender, location etc. thereby analysing their purchasing behaviour. Online frauds can be detected easily. It is very useful in face and speech recognition, automated trading, natural language processing, automotive, aerospace, etc.

## 2. Types of Learning

There are three types of learning as discussed below:

**A. Supervised learning:** It is type of learning in which we have both input and output variables. An algorithm can derive a function from input to output. It is used when we have data for the output we have to predict. Data is divided into training data as well as test data. It analyses the training data and produces an inferred function that can be utilized for mapping test data for prediction or classification.

Suppose we have a basket full of fruits like apple, grapes and banana and we have to predict whether a new fruit is apple, grapes or banana we can just analyse the features of these fruits and based on these features we can predict the new one. Taking another example if we have two types of emails spammed and nonspammed and we have to classify new mails as spammed or nonspammed. Based on the examples of previous mails which are already classified we can classify the new ones. Supervised problems can be divided into classification and regression problems. Classification is predicting a label and regression is predicting a real value. Classification algorithm applies to nominal, not ordinal response values while regression is used for responses that are a real number, such as miles per gallon of a particular car. [3,4]

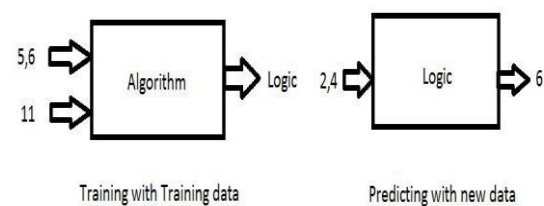


Fig.1 Example of Supervised Learning [5]

Three most used algorithms for supervised learning are discussed here:

*i) Naive Bayes:* It is used for classification. It is based on Bayes theorem of conditional probability. It works on the principle that all the features are independent of each other. In spite of this disadvantage this classifier is simple, efficient and gives good performance. Based on the training data and the features of training data we can classify the new samples. For example if we want to classify male or female based on the features hair colour, height, eye colour, etc. it is assumed that these features are independent of each other. Bayes theorem is shown in eq 1.1

$$P(X/Y) = (P(Y/X) * P(X)) / P(Y) \quad 1.1$$

$P(X/Y)$  = Posterior Probability

$P(Y/X)$  = Conditional Probability

$P(X)$  = Prior Probability

$P(Y)$  = Probability of Y which is fixed

*ii) Decision Tree:* Decision tree classifiers are used successfully in many diverse areas such as character recognition, remote sensing, medical diagnosis, expert systems, and speech recognition, to name only a few. It uses divide and conquer method. [6] It consists of tree type structure with a root node, branches which

are internal nodes and leaf nodes. Root node denotes the attribute which represents maximum information. Branches denote the result of the test done on the internal nodes and leaf node denotes the class label. The tree where the class label takes real values is called regression tree and where the class label takes discrete values is called classification tree. There are different algorithms for decision tree namely CART, C4.5, ID3, etc. Information gain and gini index are the methods for finding the feature that best divides the training data.

Advantages and disadvantages of decision tree are:

#### **Advantages**

- It is so easy to understand.
- Handles both categorical and numerical data.
- No need for data preparation.
- It uses a white box model.

#### **Disadvantages**

- Complexity: Large tree with lot of data can become complex.
- Instability: Changing data or variables can lead to redrawing the whole tree.
- Cost: Increased complexity can lead to increased cost.

iii) Support Vector Machine: It is a supervised learning technique. It is used for both classification and regression. It takes into account input variables and gives a hyperplane as output to classify new examples. For example as shown in the fig below we have to separate the circles and squares. SVM just draws a line

to separate these two.

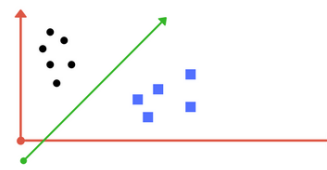


Fig 2: Shows a hyperplane to separate circle and squares.

Advantages and disadvantages of SVM are:

#### **Advantages**

- It works well even if the number of attributes is very large. It scales relatively well to high dimensional data.
- As SVM is kernel based it can model complex, real-world problems.
- The risk of overfitting is less with SVM.

#### **Disadvantages:**

- Choosing a good kernel function is not an easy task.
- When dataset is large it takes long training time.[7]

**B. Unsupervised learning:** It is a type of learning in which we have only input variables. Data is unlabelled and algorithms are used to find the interesting patterns themselves. They learn the features on their own and when new data comes they use the features learned from the previous data and group them accordingly. For example we can say we have just questions and no correct answers to match from. It is mainly used for clustering and association problems. [8].

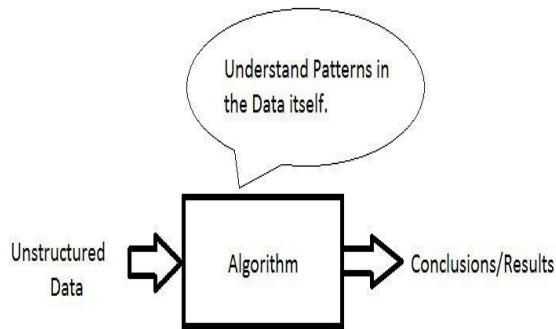


Fig. 3 Unsupervised Learning Model

Algorithms used for unsupervised learning are:

i) *Clustering*: It is the task of dividing data into number of subsets. Data items that have same properties or are similar to each other are divided into one or more subsets known as clusters. For example a shopkeeper can divide the customers on the basis of their purchasing habits. Two types of clustering are K Means Clustering and Hierarchical Clustering. Clustering can be used in Market Segmentation, social network analysis, medical imaging etc.

ii) *Association*: These techniques are used to find relations between the data items in the database. They are useful in market behavior analysis in which we can predict which items are bought together by finding the relations between them. Associations rules have two parts antecedent and consequent where antecedent consist of data item in the transaction and consequent consist of data item found in combination with antecedent. Rules are created from confidence and support factors. Support means how frequently items appear and confidence means how many times if/then statements are found to be true. For example if a customer buys bread it is more likely that he will buy butter too.

These types of relations are very useful for promoting sales. [9]

**C.Reinforcement Learning**: In this type of learning, machine is exposed to an environment in which it continuously trains itself using trial and error.[10] All possible states are discovered repeatedly to maximize performance and minimise risk. Simple reward feedback is required for the agent to learn its behaviour.

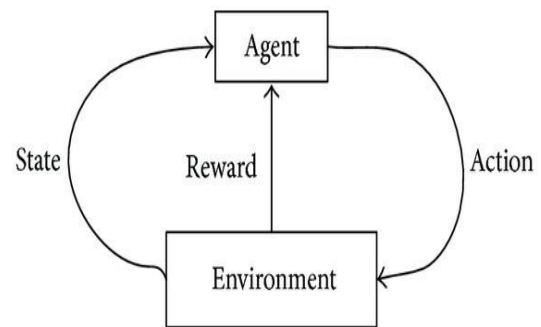


Fig.4 Model of Reinforcement Learning [11]

### 3. Applications

Machine learning techniques find use in wide number of applications like health, finance, social media, travel, email spam and malware filtering, online customer support, search engine result refining, product recommendations and lot more. Some of which are explained in detail below:

#### i) *Health*:

- Today lots of patients are suffering from various diseases which prove to be fatal. Doctors can look for symptoms and can even predict how long they will live.
- New drugs can be discovered and built easily.

- People can be made aware how to protect them from these deadly diseases.[12]

#### ***ii) Finance:***

- Online fraud is increasingly day by day. Machine learning algorithms can detect these frauds easily. For example PayPal can easily detect whether the transaction is genuine or not.
- Get advice on which investment will give maximum profit.
- It is used in banking for purposes like character recognition.[13]

#### ***iii) Social Media:***

- Face recognition: Facebook identifies similar features and suggests name for tagging. Before we select our friend name for tag already a correct name is suggested by facebook.
- Persons we visit or look for profile are suggested as our facebook friends.
- Targeted marketing: Clusters are built analysing the customers and understanding their buying behaviour.

#### ***iv) Travel:***

- GPS can find directions for our destination and even predict traffic for us.
- UBER can determine price for our ride.
- We get suggestions for hotels when we book flights for our outing.
- Trip advisor shows reviews and opinions from many people which

can help people look for their own preferences.

#### ***v) Email Spam and malware Filtering:***

- Through many lines of code, similar patterns are searched and malware are detected which can otherwise compromise with data security.
- Spam filters are updated regularly.

#### ***vi) Search Engine Result Refining:***

- When we search for results say in Google it keeps tracks at the backend whether we opened first page and got the results or looked at second or third page, etc.

#### ***vii) Online Customer support:***

- Some websites provide an online interaction system to solve the queries of their customers there and then.
- If live expert is not there then chatbots are there which provides us with answers by searching answers from the websites.

#### ***viii) Product Recommendations:***

- When we search for a product on a website then we keep receiving suggestions for the product of similar type, with same price, different brand etc.
- Things which match our taste are continuously advised to us.

#### ***ix) In Image processing and computer vision***

- It helps in image restoration, enhancement and morphing.

- It helps computer analysing the things for better clarity.

***x) Natural Language Processing:***

- It helps in text classification i.e given text we can classify the class label.
- Speech Recognition: Given an audio signal or voice clip voice can be recognised.
- Photos are there we can predict the caption for the required photo.

***xi) Automotive Industry:***

- Driverless cars.
- Mood of the driver can be predicted and many road accidents can be prevented due to driver fatigue, etc.
- Drivers are even assisted with speed limits and an automatic braking system is also provided to them.[14,15]

## 4. Conclusion

In this review paper we have discussed the basics of machine learning, its three types i.e. supervised, unsupervised and reinforcement learning and the most used algorithms of supervised and unsupervised learning. Also the applications of machine learning in various fields like health, finance, retail, travel, media, image processing and computer vision, natural language processing, automated trading, automotive, aerospace, manufacturing have been discussed in detail here.

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