International Journal of Computer Trends and Technology
ISSN: 2231-2803 / https://doi.org/10.14445/22312803/IJCTT-V68I1P105

Volume 68 Issue 1, 21-25, January 2020

Original Article

Applications of Machine Learning Algorithms

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Received Date: 09 November 2019
Revised Date: 02 December 2020
Accepted Date: 04 January 2020

Abstract *- The goal of various machine learning algorithms is to device learning algorithms that learn automatically without any human intervention or assistance. The emphasis of machine learning is on automatic methods. Supervised Learning, unsupervised learning and reinforcement learning are discussed in this paper. Machine learning is the core area of Artificial Intelligence. Although a subarea of AI, machine learning also intersects broadly with other fields, especially statistics, mathematics, physics, theoretical computer science and more. Machine learning algorithms and their purpose are to learn and perform specific tasks. Humans are always interested in making intelligent computers that will help them make predictions and complete tasks without supervision. Machine learning comes into action and produces algorithms that learn from past experiences and make decisions to do better in the future*

Keywords *- Classification, Clustering, Supervised Learning, UnSuper vised learning, Reinforcement learning.*

I. INTRODUCTION

Machine learning is a subject based on computer algorithms, and its purpose is to learn and perform specific tasks. Humans are always interested in making intelligent computers that will help them make predictions and complete tasks without supervision. Machine learning comes into action and produces algorithms that learn from past experiences and make decisions to do better in the future. Arthur Samuel, way back in 1959, said: “Machine Learning in the field of study that gives computers the ability to learn without being explicitly programmed". Thus it is what precisely machine learning is. Here, past experiences are called data. We can say that machine learning is a field that gives computers the capability to learn without being programmed. For example, a telecom company is very much interested in knowing which customers are going to terminate their service. If they know or can predict those customers, they can offer them special deals to retain them. A machine learning program continuously learns from past data and improves with time. In simpler words, if a computer program improves on a specific task based on an experience, then we can say that it has learned. Machine learning is a field that discovers structures of algorithms that enable learning from data. These algorithms build a model that accepts inputs and, based on these inputs, make predictions or results. We cannot provide all the preconditions in the program; the algorithm is designed so that it learns itself.

Sometimes, machine learning and Artificial Intelligence (AI) are used interchangeably. However, machine learning and AI are two distinctive areas of computing. Machine learning focuses solely on writing software that can learn from past experiences. Applications of machine learning include sentiment analysis, email spam detection, targeted advertisements (Google AdSense), recommendation engines used by e-commerce sites, and pattern mining for market basket analysis. Some real-life examples of machine learning are covered in the next section. Speech conversion from one language to another This Skype feature helps break the language barrier during voice/video calling. It translates a conversation into another language in real-time, allowing both speakers to share their views in their native languages effectively.

A. Suspicious activity detection from CCTVs

This is a beautiful example of how an application of machine learning can make society a safer place. The idea has a machine learning algorithm that captures and analyse CCTV footage all the time and learn from it the everyday activities of people, such as walking, running, and so on. If any suspicious activity occurs, say robbery, it alerts the authorities in real-time about the incident.

B. Medical diagnostics for detecting diseases

Doctors and hospitals are now increasingly being assisted in detecting diseases such as skin cancer faster and more accurately. A system designed by IBM picked cancerous lesions (damage) in some images with 95 percent accuracy, whereas a doctor's accuracy is usually between 75—84 percent using manual methods. So, the computing approach can help doctors make more informed decisions by increasing the efficiency of recognizing melanoma and spot cases where it is difficult for a doctor to identify it. Machine learning can be divided into three categories:

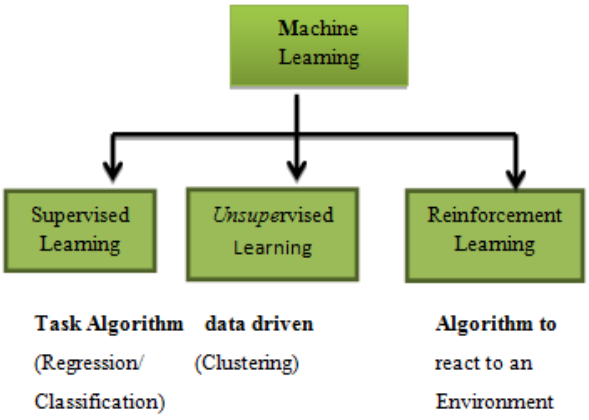

Fig. 1.1 types of Machine learning

II. SUPERVISED LEARNING

Supervised learning is a type of machine learning where we have input and output Variables. We use an algorithm to learn the mapping from the input variable to the output variable. Y = f(X) The goal here is to understand the mapping very well, enabling us to transform the input into the output. When our program receives the input data, it runs the mapping function to generate output data. Why is this called supervised learning? The algorithm used to learn from the training dataset is similar to a teacher supervising the process. For each run, the algorithm makes predictions on the training dataset, and the teacher does the correction. Once we get an acceptable level of correct predictions, the learning will stop, and the algorithm will move on to the production environment. In supervised learning, there are dependent and independent variables. We need to understand the effect of each variable used in the mapping and see the impact on the output variable. We can further group supervised learning into classification and regression problems: Classification: A classification problem is when we need to predict a category. For example, we have a patient's historical record in a hospital, and we want to expect how many people have high chances of a heart attack. Here, the output variable will be yes or no. Regression: A regression problem is when we need to predict a number or value. For example, when indicating a stock value, it always results in an actual number. There are further divisions of classification and regression problems that include time-series predictions or recommendations. Some famous examples of supervised learning algorithms are as follows: Random forest (classification or regression problems), Linear regression (regression problems), Support Vector Machines (SVM) (classification problems).

Now we will learn supervised learning from a real-life example. Let's say we are in a garden and have a bag full of different types of fruits. We need to remove all the fruits from the pack and put the same kinds of fruits together. That's an easy task because we're already aware of the physical characteristics of each fruit. For example, we know which one is mango and an apple. So, it's effortless to arrange them in groups. Here, our previous memory is working like training data. We've already learned the fruit names from the training data; here, the fruit names are output or decision variables.

Table 1.1 fruit characteristics

Sno	Colour	Size	Shape	Fruit Name
1	Green	Small	Round	Grape
2	Green	Big	Half Moon	Banana
3	Red	Small	Heart	Cherry
4	Red	Big	Round	Apple

Table 1.1: Characteristics of fruits Let's say we take out a new fruit from the bag, and now we need to place it into the correct group. We will check the colour, size, and shape of the new fruit and decide, based on the results, to put it into the correct group. For example, if the fruit size is significant, the colour is red, and the shape is round with slight curves, we can easily say it's an apple and place it in an apple group. This is called supervised learning because we've already learned something from training data, and then we apply that knowledge to the new data (test data). The technique used for this type of problem is called classification. Why? It is a classification problem because we predict a category; here, the category is fruit name.

A. Unsupervised learning

Unsupervised learning is a type of machine learning in which we have only input variables and no output variables. We need to find some relationship or structure in these input variables. Here, the data is unlabelled; that is, there is no specific meaning for any column. It is called unsupervised learning because there is no training and no supervision. The algorithm will learn based on the grouping or structure in the data, for example, an algorithm to identify that a picture contains an animal, tree, or chair. The algorithm doesn't have any prior knowledge or training data. It just converts it into pixels and groups them based on the data provided. In unsupervised learning, we group the parts of data based on similarities within each other. The data in unsupervised learning is unlabelled, meaning there are no column names. This is not important because we don't have any specific knowledge/training of the data. Unsupervised learning problems can be further grouped as clustering and association problems:

a) Clustering

A clustering problem is for discovering a pattern or understanding the way of grouping from the given data. An example is a grouping of customers by region or based on age.

b) Association

Association is a rule-based learning problem where you discover a pattern that describes a major/big portion of the given data. For example, in an online book shop, the recommendation engine suggests that people who buy book A also buy certain other books. Some popular examples of unsupervised learning algorithms are:

Apriori algorithm (association problems) K-means (clustering problems) Now take up the same fruit grouping example again from the earlier section. Suppose we have a bag full of fruits, and our task is to arrange the fruits grouped in one place. In this instance, we have no prior knowledge of the fruits; that is, we have never seen these fruits before, and it's the first time we will see these fruits. Now, how do we perform this task? What are the steps we will do to complete this task? The first step is to take a fruit from the bag and see its physical characteristics, say the colour of this particular fruit. Then arrange the fruits based on colour.

Table 1.2 Grouping Based on Color

Colour	Fruit name
Red Group	Cherries and Apples
Green Group	Grapes and bananas

Table 1.2: Grouping based on colour Now, we will group them based on size and colour. See the result in Table 1.3:

Table 1.3 Grouping based on Size and Color

Size and Colour	Fruit name
Big and Red	Apple
Small and Red	Cherry
Big and Green	Banana
Small and Green	Grapes

Table 1.3: Grouping based on size and colour It's done now! We've successfully grouped them. This is called unsupervised learning, and the approach is called clustering. Note that in unsupervised learning, we don't have any training data or past examples to learn from. In the preceding example, we didn't have any prior knowledge of the fruits.

B. Reinforcement learning

We use Machine Learning to constantly improve the performance of machines or programs over time. The simplified way of implementing a process that improves machine performance with time is using Reinforcement Learning (RL). Reinforcement Learning is an approach through which intelligent programs, known as agents, work in a known or unknown environment to constantly adapt and learn based on given points. The feedback might be positive, also known as rewards, or negative, also called punishments. Considering the agents and the environment interaction, we then determine which action to take. In a nutshell, Reinforcement Learning is based on rewards and punishments. Some important points about Reinforcement Learning:

It differs from normal Machine Learning, as we do not look at training datasets.

- Interaction happens not with data but with environments through which we depict real-world scenarios.
- As Reinforcement Learning is based on environments, many parameters come into play. It takes lots of information to learn and act accordingly.
- Environments in Reinforcement Learning are real-world scenarios that might be 2D or 3D simulated worlds or game-based scenarios.
- Reinforcement Learning is broader in a sense because the environments can be large in scale, and there might be a lot of factors associated with them.
- The objective of Reinforcement Learning is to reach a goal.
- Rewards in Reinforcement Learning are obtained from the environment.

The idea that we learn by interacting with our environment is probably the first to occur to us when we think about the nature of learning. When an infant plays, waves its arms or looks about, it has no explicit teacher, but it does have a direct sensorimotor connection to its environment. Exercising this connection produces a wealth of information about cause and effect, about the consequences of actions, and about what to do in order to achieve goals. Throughout our lives, such interactions are undoubtedly a major source of knowledge about our environment and ourselves. Whether we are learning to drive a car or to hold a conversation, we are acutely aware of how our environment responds to what we do, and we seek to influence what happens through our behaviour. Learning from the interaction is a foundational idea underlying nearly all theories of learning and intelligence.

Reinforcement learning is a type of machine learning that enables the use of artificial intelligence in complex applications from video games to robotics, self-driving cars, and more.

Reinforcement learning is learning what to do—how to map situations to actions—so as to maximize a numerical reward signal. The learner is not told which actions to take but instead must discover which actions yield the most reward by trying them. In the most interesting and challenging cases, actions may affect not only the immediate reward but also the next situation and, through that, all subsequent rewards. These two characteristics—trial-and-error search and delayed reward are the two most important distinguishing features of reinforcement learning.

Reinforcement learning (RL) formalizes the problem of learning an optimal behaviour policy from experience directly collected from an unknown environment. Such a general model already provides powerful tools that can be used to learn from data in a very diverse range of applications (e.g., see Correct successful behaviour, reinforcement learning is trying to maximize a reward signal instead of trying to find hidden structure.

- It Differs from normal machine Learning as we have done the training data sets
- Interface between the environment through the real-world scenarios
- Reinforcement learning is based on many parameters that come to play, and learning about and acting accordingly
- The reinforcement learning to use to reach the goal
- Reward in reinforcement learning obtained the environments

To demonstrate some key ideas, we start with a simplified learning algorithm that is suitable for a deterministic model, namely:

st+1 = f(st, at)

rt = r(st, at)

We consider the discounted return criterion:

V π (s) = ϒt r(st , at), given s0 = s, at = π(st)

V ∗ (s) = max π V π (s)

Recall our definition of the Q-function (or state-action value function), specialized to the present deterministic setting:

Q(s, a) = r(s, a) + ϒV ∗(f(s, a))

The optimality equation is then

V∗(s) = maxaQ(s, a)

Applications of RL to computer games, energy management, logistics, and autonomous robotics). Nonetheless, practical limitations of current algorithms encouraged research in developing efficient ways to integrate expert prior knowledge into the learning process. Although this improves the performance of RL algorithms, it dramatically reduces their autonomy since it requires constant supervision by a domain expert. A solution to this problem is provided by transfer learning, which is directly motivated by the observation that one of the key features that allow humans to accomplish complicated tasks is their ability to build general knowledge from past experience and transfer it in learning new tasks. Thus, we believe that bringing the capability of transfer of learning to existing machine learning algorithms will enable them to solve a series of tasks in complex and unknown environments.

Reinforcement learning is different from supervised learning, the kind of learning studied in most current research in the field of machine learning. Supervised learning is learning from a training set of labelled examples provided by a knowledgeable external supervisor. Each example is a description of a situation together with a specification—the label—of the correct action the system should take to that situation, which is often to identify a category to which the situation belongs.

Reinforcement learning is also different from what machine learning researchers call unsupervised learning, which is typically about finding structure hidden in collections of unlabeled data. The terms supervised learning, and unsupervised learning would seem to exhaustively classify machine learning paradigms, but they do not. Although one might be tempted to think of reinforcement learning as a kind of unsupervised learning because it does not rely on examples of or, in terms of Q only:

Q(s, a) = r(s, a) + ϒ maxa'Q(f(s, a), a')

Our learning algorithm runs as follows:

• Initialize: Set Qˆ(s, a) = Q0(s, a),

for all s, a. • At each stage n = 0, 1, . .

. : – Observe sn, an, rn, sn+1.

– Update Qˆ(sn, an): Qˆ(sn, an) := rn + ϒ maxa' Qˆ(sn+1, a')

III. THE DIFFERENCE BETWEEN MACHINE LEARNING

The similarities of the above algorithms are:

- A machine learning algorithm learns from past experiences and produces an output based on the experiences.
- The algorithms have strong relations to mathematical optimization.
- The algorithms are related to statistical computation.

Supervised learning	Unsupervised Learning	Reinforcement learning
The output is based on the training data set. classification is used here	The output is based on the clustering of data.	The output is based on the agent's interaction with the environment. It used a deterministic or nondeterministic way of learning.
Priori is necessary	Priori is not necessary.	Priori is required.
It will always produce the same output for specific input.	It will produce different outputs on each run for specific input.	The output changes if the environment does not remain the same for specific input.

IV. CONCLUSION

Machine Learning Research spans almost four decades. Much of the research has been to define various types of learning, establish the relationships among them, and elaborate on the algorithms that characterize them [9]. But, much less effort has been devoted to bringing machine learning to bear on real-world applications. But recently, researchers have found broader applications of machine learning to real-world problems. Some of these are:

- Bioinformatics
- Brain-machine interfaces
- Classifying DNA sequences
- Computational finance
- Computer vision, including object recognition

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