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Research Paper

Artificial intelligence and Machine Learning for Real-world problems (A survey)

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ABSTRACT

Today, the use of machine learning and artificial intelligence due to many advantages such as simplicity, high speed, high accuracy in predicting various processes, no need for complex equipment and tools and the availability of many applications in science and fields. Has found various including statistics, mathematics, physics, chemistry, biochemistry, materials engineering, medical engineering, pharmacy and etc. Therefore, in the present era, the study and study of various methods and algorithms of machine learning and artificial intelligence is very important. As a subset of artificial intelligence, machine learning algorithms create mathematical models based on sample data or training data for unpredictable prediction or decision making. One of the most interesting topics that can be focused on with artificial intelligence is predicting and estimating future events. Machine learning provides machines with the ability to learn independently. In other words, the machine can learn from the experiences, observations, and patterns it analyzes based on a set of data. In this regard, the paper, with the aim of introducing machine learning and artificial intelligence, deals with their application in managing and analyzing the processes of economic systems in real conditions.

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1. Introduction

Artificial intelligence is a general term for machines that have the ability to perceive, logic and learn. One of the subfields of artificial intelligence is machine learning. In this way, the computer, after processing the data, intelligently extracts the patterns in them, learns them and turns them into knowledge. This process is done in such a system without explicit programming, in fact, the system uses its algorithms and according to the results of data processing, develops its algorithm and adds new items to them and updates the car automatically (Russell & Norvig, 2002). Artificial intelligence is a science and technology based on disciplines such as computer science, biology, psychology, linguistics, mathematics and engineering (Copeland, 2015). Machine Learning is a subset of artificial intelligence that allows systems to learn and progress automatically without explicit programming (Nilsson, 2009). The main focus of machine learning is on developing computer programs that can access data and use it for their own learning. The learning process begins with observations or data, such as examples, direct experiences, or instructions, to arrive at a pattern in the data and make better decisions based on the examples we provide. The main goal is to allow the computer to learn automatically without human intervention and to be able to adjust its actions accordingly (Jordan & Mitchell, 2015). The three main methods of machine learning include supervised learning, unsupervised learning, and deep learning. Each of these learning methods involves several different types of algorithms depending on the type of subject matter, one of these algorithms should be used (Ghahremani nahr et al., 2020). Machine learning greatly helps to save operating costs and improve the speed of data analysis. Machine learning is the scientific study of algorithms and statistical models used by computer systems that benefit from algorithms and inferences to perform tasks instead of using clear instructions (Zhang, 2020). In other words, machine learning is one of the subsets of artificial intelligence that allows systems to learn and progress automatically without the need for programming (Aliahmadi et al., 2016). The main focus of machine learning is on developing computer programs that can access data and use it for their own learning. In fact, machine learning occurs when we encounter a complex task or problem that cannot be solved by conventional methods or we are faced with a large amount of data and variables that cannot be processed and calculated by human resources using traditional methods, and we do not even have formulas or equations to help solve them (Sra et al., 2012). That is why machine learning has become a hot topic because of the benefits it brings to investors, as well as the changes it can make in other areas. This has led many people around the world to want to study artificial intelligence and machine learning (El Naga & Murphy, 2015). Also, for people who do not specialize in artificial intelligence, the study of artificial intelligence and its capabilities has become a very important issue because in today's world, machine learning integrates with many areas and processes, and therefore people who want to lead They should know about it in advance.

In the continuation of this paper, the dimensions and components related to artificial intelligence and machine learning and their basic applications in today's real world will be studied and defined.

2. Machine learning steps

Machine learning is one of the most important subsets of artificial intelligence. Machine learning is a machine model that is designed to learn and act on a set of real or simulated examples and data, using algorithms without explicitly planning and dictating individual actions. The goal of machine learning is for computers and systems to be able to perform the desired task gradually and with increasing data. The range of machine learning research is very wide. Theoretically, researchers are trying to create new learning methods and study the feasibility and quality of learning for their methods, and on the other

hand, some researchers try to apply machine learning methods to new issues. Of course, this spectrum is not discrete and the researches have components of both approaches. The following describes the machine learning processes. The steps of analyzing machine learning processes include data collection and preparation, model selection and training, and setting and predicting super parameters (Sammut & Webb, 2011).

2.1. Data Gathering

The first step in the machine learning process is to provide the knowledge and data needed for the machine. This data is divided into two groups. The first group is used to train the system and the second group is used to test the system. It should be noted that the selected data represent the entire population. The data is usually divided into 20/80 or 70/30, to ensure that the model can be tested later after adequate training (Dietterich, 1997).

2.2. Model Selection and Training

The second and next step in the principles of machine learning is model selection and training. There are several types of machine learning algorithms and models that have already been developed and modified to solve a specific type of problem or problem. Therefore, depending on the need and suitability of the model to solve the problem, a model is selected and taught (Ghahremani nahr et al., 2021).

2.3. Model Evaluation

The machine learns different patterns and properties from the data it is taught and trains itself to make decisions in various areas such as identifying, classifying, or predicting new data. Predictions should be tested on trained data to accurately examine how the machine is able to make these decisions. To do this, first activities are performed on the trained data and after training the model, it is used for data-based testing to determine how accurate it is (Burkov, 2019).

2.4. Prediction and Adjustment of Super parameters

In machine learning terms, superparameters are parameters that cannot be estimated by the model itself, but need to be considered because they play a very important role in increasing the performance of the model. If we want to provide a definition, superparameters in machine learning are parameters that must be specified by the user to run the algorithm. Classic parameters are taught by data, while superparameters may learn from data. A model can have a large number of superparameters, and the process of selecting the best possible combination of superparameters is called superparameter setting. Some basic methods for setting hyperparameters include network search, random search, or gradient-based optimization. After completing the process of optimizing the superparameters, it can be said that the machine learning model has been built and depending on its success rate or its accuracy, its predictive ability, it can be implemented in the real world. Therefore, with the help of the above methods, a machine learning algorithm can be built (Rose, 2016).

3. Segmentation of Problems

One of the most common classifications in machine learning is segmentation based on the type of data available to the smart broker. Accordingly, learning is divided into three different categories, including unsupervised learning, supervised learning and deep learning. The following is a description of these categories.

3.1. Supervised Learning

This type of learning is applicable to labeled data because the learning process (from training data) of an algorithm is controlled by an observer. In this way, the "learning algorithm" estimates the output of the training data in different iterations, and then these outputs are corrected by an observer, and when the algorithm reaches an acceptable performance, the learning process stops. Supervised learning requires a number of input data in order to train the system. Supervised learning is itself divided into two categories: regression and classification. Regression is those issues whose output is a continuous number or a set of continuous numbers, such as house price forecasts based on information such as area, number of rooms, etc. Classification refers to those issues whose output is part of a set, such as predicting whether an email is spam or predicting the type of illness a person has out of ten diseases. Figure 1 shows a schematic of supervised learning (Caruana & Niculescu-Mizil, 2006).

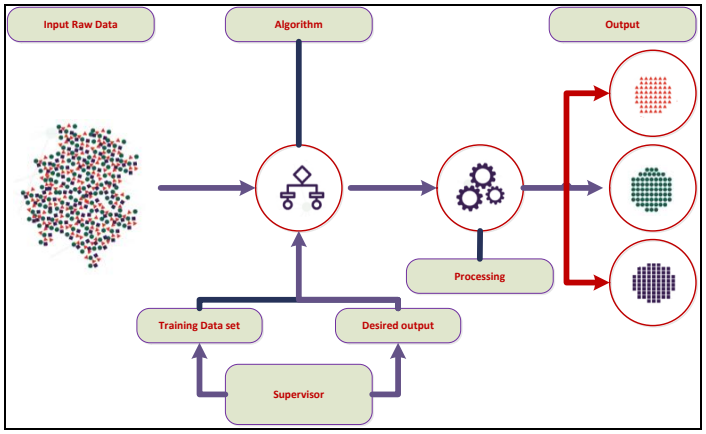

Figure 1. Supervised Learning.

3.2. Unsupervised Learning

Unsupervised learning versus supervised learning is one type of machine learning method. If learning is done on unlabeled data and to find hidden patterns in this data, learning will be unsupervised. In fact, unlike supervised learning, unsupervised learning uses input data to infer and model patterns without the need for tagged results. In this category of learning we have only raw data that is not labeled. In fact, there is no observer here to help the algorithm learning (Nouri et al., 2019). The main purpose of unsupervised learning is to model the distribution of data so that it can learn more about the data. This model of learning has to find the hidden structure of unlabeled data itself. Unsupervised learning is divided into two categories: clustering and dimension reduction. Figure 2 shows a schematic of unsupervised learning (Barlow, 1989).

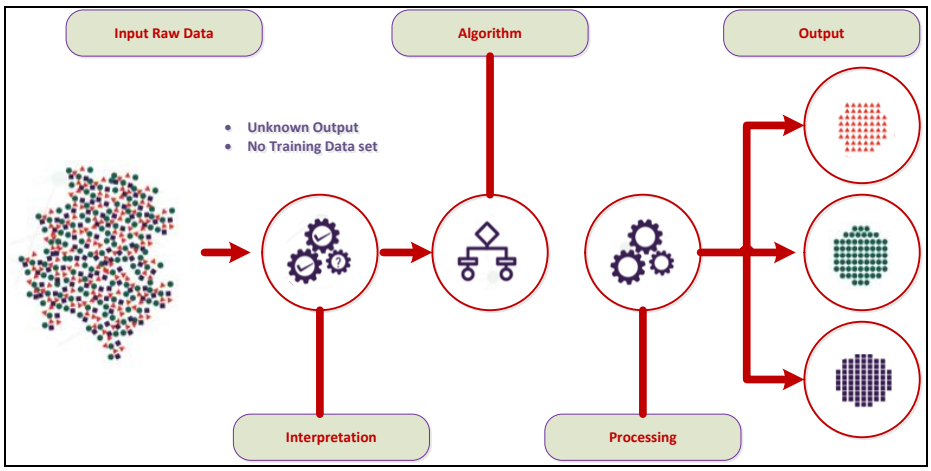

Figure 2. Unsupervised Learning.

3.3. Reinforcement Learning

The goal of reinforcement learning, which is part of machine learning, is how software agents must select the action that suits the environment to maximize optimal rewards. This type of learning is inspired by the psychology of behaviorism. This method focuses on the behaviors that the machine must do to maximize its reward and by rewarding it tries to follow the best path with the goal of perfectionism. Reinforcement learning in various fields such as game theory, control theory, operations research, theory Information, multi-agent system, congestion intelligence, statistics, genetic algorithm, optimization based on simulation are examined. Reinforcement learning has two major differences with supervised learning. First, it does not explicitly define input and output, and second, there is a strong focus on live performance and online learning, which requires finding the right balance between exploring new things and exploiting. It has accumulated knowledge. Reinforcement learning in manufacturing, automobiles, business management, computer systems, machine vision, education, energy, finance, games, healthcare, natural language processing (NLP), robotics, "science, engineering and art" And transportation is used. For example, Google's translation service uses enhanced learning (Mehrabi et al., 2021).

4. Machine learning algorithms and problem solving approaches

Various methods have been introduced for machine learning, the study of each of which requires the creation of separate manuscripts. In the following, we will introduce some very practical cases.

4.1. Artificial Neural Networks

These networks are designed based on the function of the human brain, and instead of neurons in the human brain, artificial neurons are used in a computer algorithm and can have an input or output, which is usually a number. The input of the same features of our data, such as area and life, is given through the input neurons, and the output is the same as the price of the building. Figure 3 shows an image of a simple artificial neural network that wants to output y with the help of the m attribute x (Goh et al., 2021).

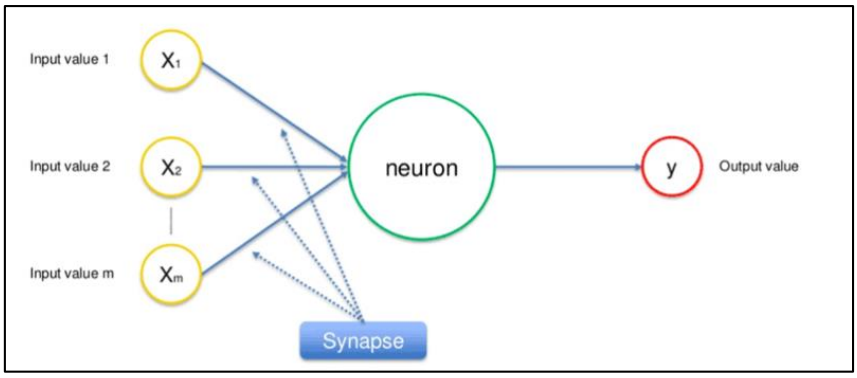

Figure 3. A simple artificial neural network.

4.2. Deep Learning

These are the artificial neural networks to which we have added many neurons as intermediate layers. These networks are more powerful and more complex to learn. These networks also have their own classification, an example of which is called convolutional neural networks. Figure 4 shows an example of deep grids that have three middle and hidden layers.

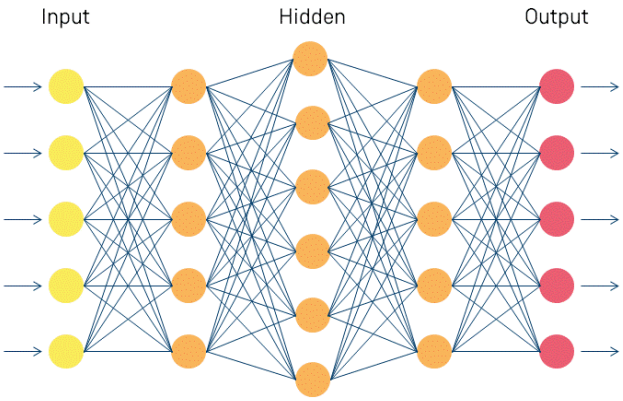

Figure 4. An example of a deep learning network.

Deep learning is a subset of machine learning whose distinguishing feature is its problem-solving method. Machine learning requires a domain specialist to identify more functional features. Deep learning, on the other hand, gradually acquires features, thus eliminating the need for domain expertise. This makes deep learning algorithms take longer to train than machine learning algorithms that only take a few seconds to a few hours. However, when testing, the opposite is true. Deep learning algorithms take less time to perform tests than machine learning algorithms that increase test time with data size (Abdullah et al., 2021). Deep learning has many applications in industry; from automatic driving to technologies used in medical devices.

One of the most popular types of deep neural networks is the Convolutional Neural Network, also known as ConvNet or CNN for short. This method has had many successes; because at CNN, as the data and the size of the model increase, the neural network expands and adapts. It can also be trained in back propagation. CNN eliminates the need to extract features; this means that we do not need to specify its properties to categorize images. CNN automatically extracts image properties directly. CNN's features make it very accurate in machine vision tasks, such as sorting objects. CNNs learn to recognize the various features of an image using tens and hundreds of hidden layers of neural network. Each

additional layer increases the complexity of the properties. For example, the first layer can learn to recognize the edges of objects; while the last layer learns to identify the complex shapes and curvatures of objects (Aliahmadi et al., 2013).

5. Machine learning Applications

So far the article has talked more about what and how to learn machine learning processes and its concepts. Now we want to look at the applications of artificial intelligence and the different areas in which artificial intelligence is used. Figure 5 shows some of the basic applications of machine learning and artificial intelligence (Zhang et al., 2021).

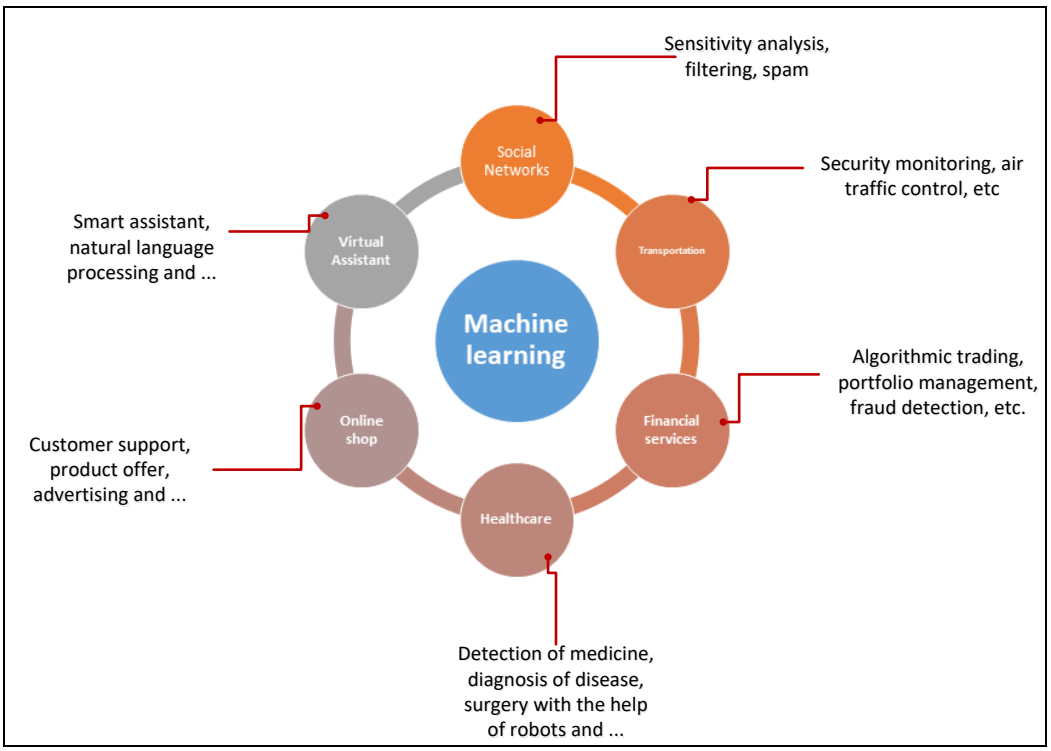

Figure 5. Some applications of machine learning.

5.1. Image processing

One of the most common applications of machine learning is image recognition. There are many opportunities to categorize objects in digital images, and machine learning can be used to do this. For example, in black and white images, each pixel is used as a unit of measurement. In color images, each pixel uses a unit of measurement for the intensity of the three colors red, green, and blue. Machine learning can also be used to identify faces in image processing. In a database, there is a separate category for each person, and machine learning algorithms use these images to identify. Machine learning is also used to recognize handwriting in ordinary writing or printed manuscripts.

5.2. Speech recognition

One of the applications of machine learning is speech to text conversion. This is also known as computer speech recognition with automatic speech recognition. With the help of speech recognition, a software can recognize the words in a speech and convert it into a text file. The unit of measurement here can be

a chain of numbers that symbolize speech signals. Speech signals can also be strongly divided into different time frequency bands. Speech recognition can be used in applications that have an interactive voice interface or voice search capability, etc.

5.3. Diagnosis of the disease

Machine learning can be used in techniques and tools used to diagnose diseases. This technology can be used to analyze clinical parameters and combine them to predict disease progression, extract medical information, research to achieve results, treatment planning, and patient monitoring. These are successful applications of machine learning methods. The use of machine learning algorithms can also help integrate computer systems and healthcare departments.

5.4. Statistical analysis

In economics, one of the most important issues is to obtain short-term strategies for buying and selling securities. To obtain these strategies, the user uses trading algorithms to buy and sell securities based on factors such as historical correlations and centralized general economic variables. Machine learning can be very useful for obtaining these short-term strategy algorithms.

5.5. Forecasting

Machine learning can be used in predictive systems. For example, according to what was said above for bank loans, to calculate the probability of system error, it is necessary to classify the data in different groups. This set is defined by the rules set by analysts. After classification, the probability of error can be calculated again with the help of machine learning. These calculations can be used in all sectors for a variety of purposes. Prediction is one of the best applications of machine learning.

5.6. Financial services

Machine learning has many potentials for use in finance and banking. Using machine learning and artificial intelligence can provide popular financial services. Machine learning can help banks and financial institutions make more informed decisions, provide financial services to detect an account closing before it occurs, track customer cost patterns, perform market analysis, track patterns Teach cost to smart machines, and finally machine learning algorithms can easily identify trends and trends ahead and react in real time (Abdullah, 2021).

6. Examples of the application of machine learning in various industries

Some of the different applications of machine learning in different industries are mentioned below. Due to the volume of applications in today's world, only a few specific cases will suffice.

6.1. Financial services

Researchers at Rutgers University's Art and Art Intelligence Laboratory wanted to see if a computer algorithm could easily identify and classify paintings based on the style, genre and artists of those works. The researchers did this by identifying and learning visual features to classify painting styles into artificial intelligence. The advanced machine learning algorithms and their artificial intelligence categorize painting styles in the database with 60% accuracy, surpassing ordinary non-experts in recognizing and categorizing works and performing better.

The researchers hypothesized that visual features for classifying style (ie, a problem with supervised learning) could also be used to determine artistic effects (a problem with unsupervised learning). They

then used algorithms to classify and train on objects that were on Google to identify specific objects. They tested these algorithms on more than 1,700 paintings by 66 different artists who worked for more than 550 years. These algorithms easily identified related effects (Hong et al., 2021).

6.2. Optimization of HVAC energy consumption in large buildings

Heating, ventilation and air conditioning (HVAC) systems in office buildings, hospitals and other large commercial buildings are often inefficient because they do not take into account climate change patterns, variable energy costs or the building's thermal properties.

BuildingIQ cloud-based software platform can easily solve this problem. The platform uses advanced algorithms and machine learning methods to continuously process and process large amounts of gigabytes of information such as electricity meter data, thermometers and HVAC pressure sensors, as well as air and energy costs. In particular, machine learning is used to split data and determine the relative share of gas, electricity, steam, and solar energy in heating and cooling processes. The BuildingIQ platform reduces HVAC energy consumption in large-scale commercial buildings by 10 to 25% during normal time (Nozari et al., 2019).

6.3. Self-driving cars

Waymo is a branch of Google Automated Car Project. The goal of this project is to build cars that can drive on their own without a human driver. To do this, the Waymo fleet needs the serious help of artificial intelligence. Waymo cars use machine learning to see their surroundings, give them meaning, and predict how others will behave. Despite the many variables that change their behavior along the way, an advanced machine learning system is essential to success (Scanlon et al., 2021).

6.4. Detection of failure in textile products

In terms of complexity and variety in patterns and materials of fabrics, identification and detection for fabrics with net image processing methods faces many challenges. In this case, by using images of healthy fabrics in large volumes, it is easy to train a deep neural network and take advantage of its efficiency. This inspection can detect any change in color and texture or scratches and defects in the fabric.

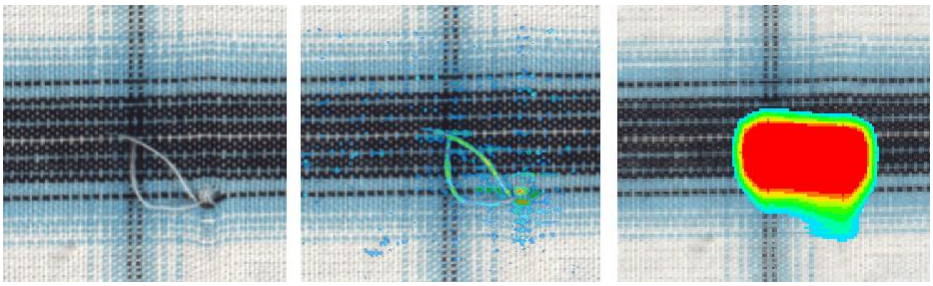

Figure 6. An overview of fault detection in the textile industry using machine learning.

6.5. Transportation

Data analysis is one of the key applications of machine learning in the transportation and transportation industries to determine patterns and find various trends in the field of transportation, such as the type of goods, popular destinations and major cities of origin. Using machine learning, it is possible to determine the optimal routes for transporting goods in and out of the city, and to find possible problems in different routes and prevent their occurrence. All of this increases profits for the transportation industry, wholesalers, retailers and customers. In addition, the security of intra-city and inter-city transportation will be improved.

7. Conclusion

Today, different parsing data and different algorithms are used to model different problems. The amount of data generated by humans and machines is so great that the absorption, interpretation, and complex decisions based on that data go beyond human capabilities. Artificial intelligence forms the basis of all computer learning and is the future of complex decision making. The use of computers in calculating these combinations and displacements is very useful for achieving the best decision. Artificial intelligence (and its evolution in machine learning) and deep learning is the key to making decisions about business and many other areas. Artificial intelligence can do many of the processes in a business on its own, dramatically reduce the workforce, and increase an organization's efficiency, save time and money, and many other resources. All of this is important to AI, especially for businesses. Of course, artificial intelligence can also transform people's private lives. For this reason and the amount of different applications that exist for artificial intelligence and machine learning in today's world, in this paper, we first tried to express the place of machine learning and its types in simple language. Then the types of algorithms used by data science experts are described here. The reader should apply one or more machine learning algorithms according to the problem encountered to see which model is most accurate and efficient. There is also a combination of different machine learning models to maximize accuracy.

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