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1 Introduction

This report will go through the concept of machine learning and its applications, types, latest development, python libraries and one of its algorithms.

2 What is Machine Learning

Machine Learning is considered as a part or application of Artificial Intelligence. Its algorithms that give the systems the ability to learn automatically, improve and enhance their process without needing to be explicitly programmed because they rely on inference and pattern. Also, it relies on statistical analysis to predict accurate outputs which help in quality improvement of the process and the results.

3 Applications of ML

Machine Learning is used in many industries and fields, it gives competitive advantage as it helps to improve their services and keep them creative. They also play a core role in customer satisfaction. As examples :

3.1 Medical field

It helps in Radiology especially in image analysis where it can help to classify the results if it's normal or abnormal. It is used to create personalized medicine by analyzing the patient's medical history to predict multiple treatment options for him. Google's DeepMind Health helps the researchers to develop algorithms to detect cancerous and normal tissue.

3.2 Finance

They help to analyze the customer's activities to suggest them financial advice. They estimate the level of risks related to the stock market, insurance and loans and protect the financial companies and their customers from future fraud. Also, they help in investment prediction as they can recognize the market trends and changes earlier.

3.3 Digital Assistant

There are many examples as Allo by Google which can suggest reply to a message and analyze the pictures sent to the user to help with suggestion. The famous assistant Siri by Apple and Cortana by Microsoft which learn the user behavior and provide help related to his needs, recognize voice and answer questions, help in management and set reminders.

3.4 E-commerce

Recommendations are an example ,they are giving related to the customer purchase and activities. Also, it can help in estimating the best price for each product by detect the purchase. It can help in customer retention so you will know if the customer is will not come back any more and solve this quickly by provide him with offers for example. Finally, search results where they will be ranked based on the pattern of the customer preference and activity not only the keywords.

4 Types

4.1 Supervised Learning

Is learning under supervision . It's focus on singular task by provide the algorithms with many examples that consist of inputs and outputs. Since the machine is already know the properties of the input it can predict the results and perform the task by mapping the given input to the desired predicted output. It's consider as the popular type of Machine Learning since it's simple to implement and easy to understand. One application is face recognition when it's take a photo of your face , try to find it then guess your identity.

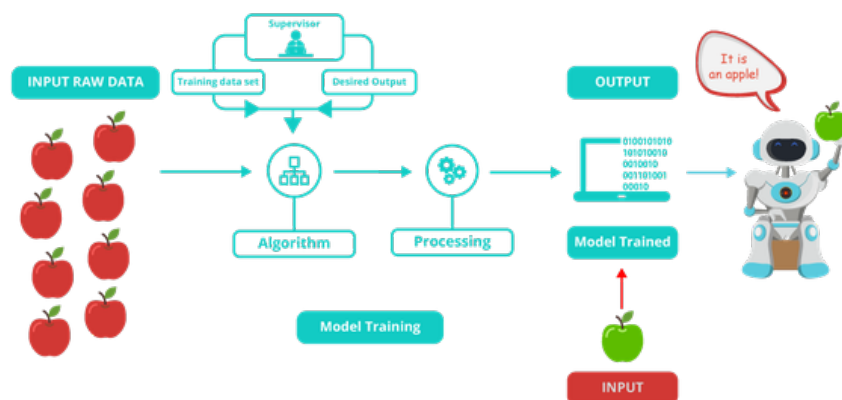


Figure 1: Supervised learning. Source : medium.com

4.2 Unsupervised Learning

Is the opposite of supervised learning. Here the machine will have no labels to mapped since it doesn't know the features of the inputs. There is no desired outcome or output to predict , the algorithm will have plentiful data and a tool to understand their properties and features then organize or group them depending on their properties similarity in a way that human can understand. One application is using the customers buying habits stored in the database to categorize the customers depending on their buying segments then the company will release their marketing to those segments.

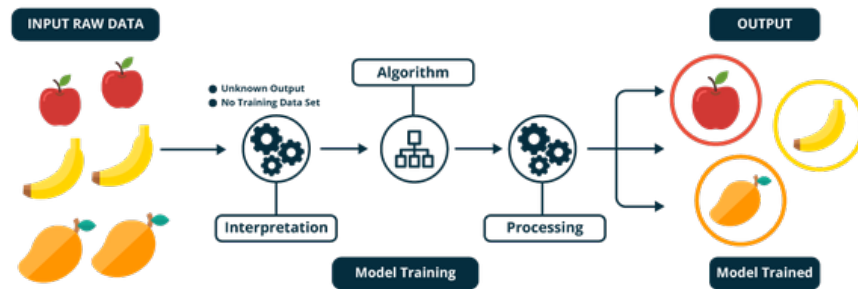


Figure 2: Unsupervised learning. Source : medium.com

4.3 Reinforcement Learning

We can't compare this type to the previous because it's fairly different. This type is behavior driven since it's learn from mistakes. We need a learning environment and agent (algorithm) connected via loop. The algorithm will have many actions to try in the environment and depending on the results it get it will improve the upcoming action. Video games are the popular example of this type.

5 Latest developments

5.1 Samsung's talking head

Samsung AI center discover a way to take a picture of a person and turn it into talking head with real motions.

5.2 Vid2Vid

Video to video technique by NVIDIA's convert semantic label maps from input video into high resolution with unbelievable precision output video that depicts the content of the input video.



Figure 3: Semantic Labels into Cityscapes Street Views. Source: [tcwang0509.github.io](https://github.com/tcwang0509)



Figure 4: Face to Edge to Face example. Source: [tcwang0509.github.io](https://github.com/tcwang0509)

5.3 Self-driving cars

They could evaluate the driver condition using sensors for example the car will drive itself to the hospital if it sense something wrong with the driver.

5.4 Object detection

Detect all the different object in the image. For example its used in image search.

5.5 Image colorization

Convert grayscale photographs and old movies into colors.

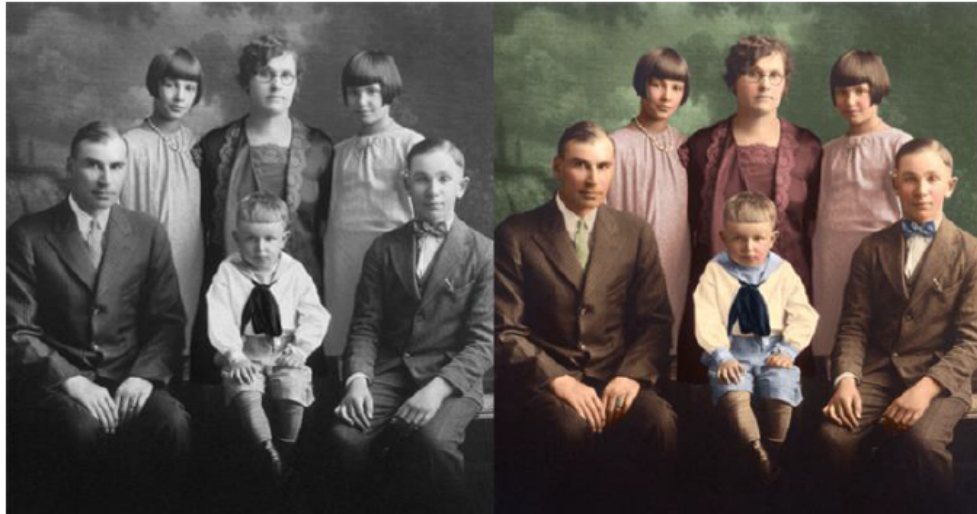


Figure 5: Image colorization. Source: photodoctortn.com

6 Python libraries used in ML Libraries

Libraries are predefined algorithms that can be called using their name to provide specific operation instead of writing the algorithm from the scratch each time you want to use it. They save time and support efficient work. One reason that Machine Learning use python is that it have many mathematical libraries with huge number of functions and methods. The most common libraries are Pandas, NumPy, Theano, Matplotlib and TensorFlow.

6.1 Pandas

It's an open-source data science library to capture data into clear structure which provide better analysis created by Wes McKinney. It has been implemented in various applications like Uber.

6.2 NumPy

NumPy is the most helpful library in scientific computing as it provides advance mathematical functions, support matrices and multidimensional arrays , and random numbers capabilities . It's consider as the fundamental library in python and machine learning which invented by a professor called Jim Hugunin.

6.3 Theano

Theano is a library that have been developed by Montreal Institute for algorithms learning. It has the same role as NumPy but it's most used in building neural networks and it's help to simplify models creation.

6.4 Matplotlib

Is a library created by John Hunter to provide straightforward 2D visualizations using plentiful number of graphs as spectrogram, stem plot and error chart.

6.5 Tensorflow

Google Brain team release this library to support distributed computing which make the graphs computed in different servers and processes. It's utilized in identify objects from pictures and voice recognition.

7 Discussion of favorite ML algorithm

7.1 Random forest classifier

It's an algorithm consist of decision trees as it's building blocks. Each individual tree give a prediction of a class then the class with the most votes from the trees will be the final prediction. Each tree is independent so any error occur in one will not affect the others. This algorithm gives more accuracy comparing to the individual prediction. It used RandomForestClassifier class implemented from sklearn.ensemble library which has many parameters but mostly take the number of trees.

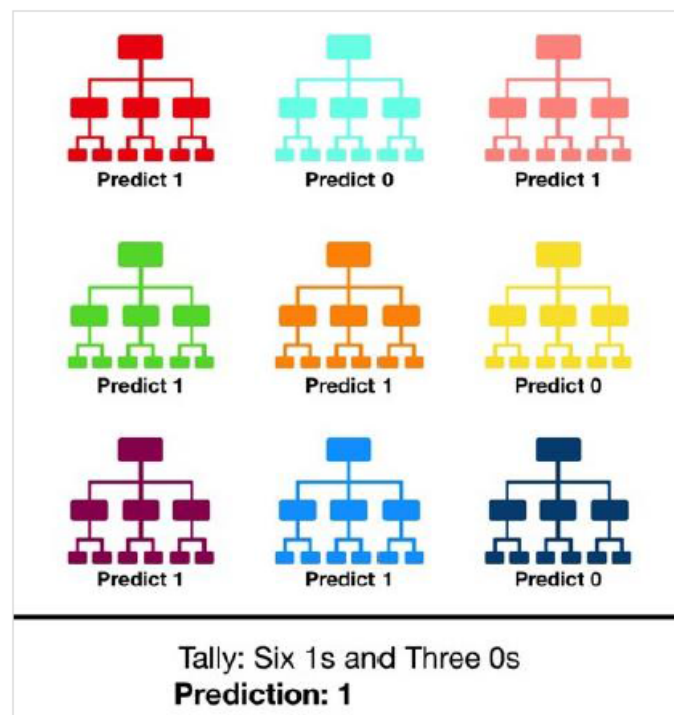


Figure 6: Random forest classifier. Source : towardsdatascience.com

This algorithm used in many field like news classification, cancer detection and stock market prediction.

8 Conclusion

Machine learning is a deep world of knowledge. This report covered a snapshot of it where is there is more than the types, applications, python libraries and the mentioned field of developments.

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