





Mathematical correlations of machine learning, which is a component of artificial intelligence

Hüseyin Fırat Kayıran^{*1}, Ulviye Demirbilek², Mesut Türk³

¹ARDSI, Mersin Provincial Coordination Unit, Mersin, Türkiye, huseyinfirat kayiran@tkdk.gov.tr

²Mersin University, Department of Mathematics, Türkiye, ulviydemirbilek@mersin.edu.tr

³Malazgirt Secondary School, Şahinbey, Gaziantep, Türkiye, mesut252@gmail.com

Cite this study: Kayıran, H. F., Demirbilek, U., & Türk, M. (2023). Mathematical correlations of machine learning, which is a component of artificial intelligence. *Advanced Engineering Days*, 8, 4-7

Keywords

Artificial intelligence
Mathematics
Machine learning

Abstract

Artificial intelligence can be explained as a mathematical phenomenon. Artificial intelligence comes together from systems that imitate human intelligence. Driverless cars, robots, vacuum cleaners, games are used in automated trading, corporate resource management. In general; robots and unmanned aircraft can be produced with artificial intelligence. The main basis that creates artificial intelligence is mathematics. Machine Learning has also become an indispensable part of our lives today as a sub-branch of artificial intelligence. In this study, the literature review was conducted and the studies about Machine Learning were mentioned. The findings obtained by establishing mathematical correlations are explained.

Introduction

Machine learning (Machine Learning) is replacing artificial intelligence as a branch that uses statistics and computer science and has recently become very popular. Artificial intelligence can be called the process of creating models based on existing data and defining complex relationships. Since past studies have shown the necessity of machines to learn data, research has focused on this issue [1]. The purpose of machine learning is to create systems that make predictions by making inferences from mathematical and statistical operations and data. Today, many different machine learning models have been born for the inference process [2] The manufacturing industry needs support to take advantage of data-intensive availability to meet its needs, such as quality improvement initiatives, production cost estimation, process optimization, and a better understanding of customer requirements [3].

Artificial Intelligence (AI)

We can define artificial intelligence in many ways. For example, it is the ability of a computer system to imitate human cognitive functions such as learning and problem solving. Through artificial intelligence, a computer system uses mathematical functions and logic to mimic thought processes that allow people to learn from new information and make decisions [4]. The concept of machine learning was invented by American researcher Arthur Samuel, who worked at IBM. In 1959, he created the first checkers program that could play by itself and learn by itself [5]. Artificial intelligence machines use various algorithms to successfully complete their tasks or achieve their goals. These algorithms have been developed using various approaches such as case-based reasoning, artificial neural network, statistical approaches, rule-based approaches and many more techniques [6]. Although artificial intelligence usually refers to the intelligence displayed by machines, it is an innovative technology that takes place in many areas of our lives, from semi-autonomous cars on the road to robotic vacuum cleaners in our homes [7]. The purpose of machine learning is to ensure that machine hardware has the intelligence and ability of humans by artificial methods. As scientists continue to have doubts about intelligence, there is no definitive definition of artificial intelligence in the scientific community [8]. The taxonomy and subfields of artificial intelligence, which are quoted from a sample study, are given in Figure 1 [9].

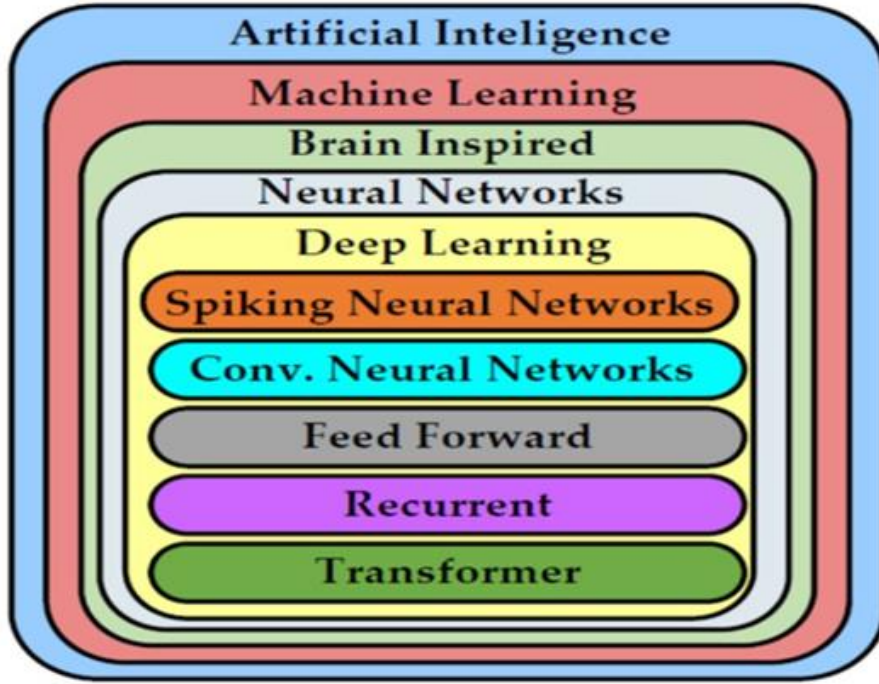


Figure 1. The taxonomy of artificial intelligence.

Machine Learning

Some information about machine learning is given above. Again, to give information about this topic; It is a set of algorithms that parse data sets and then learn to apply what has been learned to make informed decisions. It imitates human intelligence. It consists of the training and testing phase. At the learning stage, a new model is created by using the examples in the data set and learning the algorithms and features into the system. As a result, the desired results can be achieved by estimating the trial data with the Learning model application engine [10-11-12]. It imitates human intelligence. It consists of the training and testing phase. At the learning stage, a new model is created by using the examples in the data set and learning the algorithms and features into the system. As a result, estimates are made for the trial data with the Learning model application engine. The results obtained are successful [10-11-12]. The single most important concept from calculus in the context of machine learning is the gradient. Gradients generalize derivatives to scalar functions of several variables. The gradient of $f: \mathbb{R}^d \rightarrow \mathbb{R}$, denoted ∇f , is given by [13]. An example theorem used for machine learning is given in Equation 1.

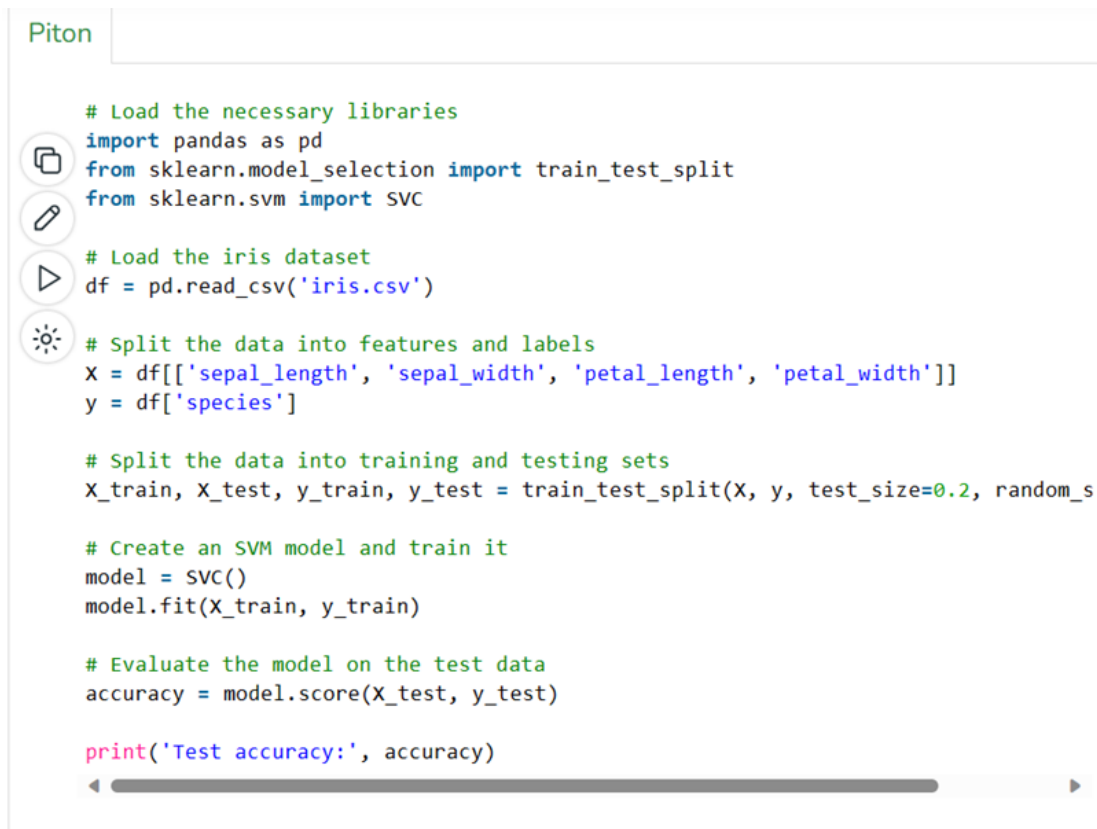
$$\nabla f = \begin{bmatrix} \frac{\partial f}{\partial x_1} \\ \vdots \\ \frac{\partial f}{\partial x_n} \end{bmatrix} \quad \text{i.e.} \quad [\nabla f]_i = \frac{\partial f}{\partial x_i} \quad (1)$$

Literature review of studies conducted through mathematical codes used within the scope of machine learning

In this section, a literature search was conducted for scientific studies that make human life easier by using machine learning and mathematical functions. The bibliographies of the findings obtained are indicated. Machine learning is the ability of computers to make decisions and create solutions about similar events that will occur in the future by learning information and experiences related to an event in another language [15]. For example; Hegg's rule If cell A is close enough to stimulate cell B and is constantly involved in activating cell B, changes can be made to one or both cells so that the effectiveness of cell A is increased [14]. Again, to briefly mention a mathematical algorithm; the self-learning algorithm updates a memory matrix $W = |w(a,s)|$ So that it can execute the following machine learning procedure at each iteration: Perform the action A in case S, get the result state s' , Calculate the Feeling of Being in the Result State $V(S')$

Update the crossbar memory $w'(a,s) = w(a,s) + v(s')$ [16]

The following is an example excerpt from a website; a simple example of machine learning in Python that shows how to train a model to predict the types of iris flowers based on dish leaf and petal measurements is given below [17]:



```

Piton

# Load the necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC

# Load the iris dataset
df = pd.read_csv('iris.csv')

# Split the data into features and labels
X = df[['sepal_length', 'sepal_width', 'petal_length', 'petal_width']]
y = df['species']

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_s

# Create an SVM model and train it
model = SVC()
model.fit(X_train, y_train)

# Evaluate the model on the test data
accuracy = model.score(X_test, y_test)

print('Test accuracy:', accuracy)

```

Figure 2. Estimation of iris flower species in Python based on dish leaf and petal measurements [17]:

As can be understood from Figure 2, the reference number given above, a mathematical software is being developed by coding. In a different study, dentists used artificial intelligence. Analysis has been performed in orthodontics using artificial intelligence and machine learning. The results obtained have been positively shared with the literature [18]. In a different study, they tried to diagnose Breast Cancer on the Kent Ridge 2 data set with the help of machine learning techniques, mathematical codes were used in the results obtained. It is understood that the results offer positive contributions to the literature [19]. In a dark study conducted by; they used the traditional classification method and SVM algorithm from machine learning algorithms for the detection of diabetes disease. As a result, they detected the disease with a success rate of 0.924 [20]:

Conclusion

In this study, literature studies on the applicability of machine learning, which is a sub-branch of artificial intelligence, through mathematical correlations were examined. In the study, the definition of machine learning was made and the applications of mathematical function were investigated. In the results of the study, it is thought that machine learning can be used to make inferences with mathematical techniques along with software and data prepared in a desired study.

References

1. <https://www.oracle.com/tr/artificial-intelligence/machine-learning/what-is-machine-learning/>
2. https://erdincuzun.com/makine_ogrenmesi/makine learning-methods/
3. Davis, J., Edgar, T., Graybill, R., Korambath, P., Schott, B., Swink, D., ... & Wetzel, J. (2015). Smart manufacturing. Annual Review of Chemical and Biomolecular Engineering, 6, 141-160. <https://doi.org/10.1146/annurev-chembioeng-061114-123255>
4. <https://cig-rdlab.gitbook.io/ml/lectures/zanyatie-1>
5. <https://practicum.yandex.ru/blog/chto-takoe-mashinnoe-obuchenie/>
6. Vaishya, R., Javaid, M., Khan, I. H., & Haleem, A. (2020). Artificial Intelligence (AI) applications for COVID-19 pandemic. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 14(4), 337-339. <https://doi.org/10.1016/j.dsx.2020.04.012>

7. Li, J. H. (2018). Cyber security meets artificial intelligence: a survey. *Frontiers of Information Technology & Electronic Engineering*, 19(12), 1462-1474. <https://doi.org/10.1631/FITEE.1800573>
8. Wang, H., Feng, Y., Xing, B., Zhang, X., Wang, Z., Wu, J., & Huang, X. (2021). A Blockchain-based Protocol for Power Data Preservation in Ping Dingshan vs. Wang Case. In 2021 IEEE 4th International Conference on Electronics and Communication Engineering (ICECE), 43-48. <https://doi.org/10.1109/ICECE54449.2021.9674419>
9. Khan, F. H., Pasha, M. A., & Masud, S. (2021). Advancements in microprocessor architecture for ubiquitous AI— An overview on history, evolution, and upcoming challenges in AI implementation. *Micromachines*, 12(6), 665. <https://doi.org/10.3390/mi12060665>
10. <https://www.ibm.com/topics/machine-learning>
11. Sandhya, N., & Charanjeet, K. R. (2016). A review on machine learning techniques. *International Journal on Recent and Innovation Trends in Computing and Communication*, 4(3), 451-458.
12. <https://www.oracle.com/tr/artificial-intelligence/machine-learning/what-is-machine-learning/>
13. Thomas, G. (2018). *Mathematics for Machine Learning*. PHD Thesis, University of California, Berkeley, 47.
14. Hebb, D. O. (2005). *The organization of behavior: A neuropsychological theory*. Psychology press.
15. https://en.wikipedia.org/wiki/Machine_learning
16. Öztemel, E. (2006). *Yapay sinir ağları*. Papatya Yayınevi.
17. <https://www.geeksforgeeks.org/getting-started-machine-learning/>
18. Büyük, S. K., & Hatal, S. (2019). Artificial intelligence and machine learning in orthodontics. *Ortadoğu Tıp Dergisi*, 11(4), 517-523. <https://doi.org/10.21601/ortadogutipdersisi.547782>
19. Bektaş, B., & Babur, S. (2016). Performance Evaluation of Breast Cancer Diagnosis Using Machine Learning Techniques, *TipTekno"16 Medical Technologies Congress*, October 27-29, Antalya.
20. Jain, D., & Singh, V. (2018). Feature selection and classification systems for chronic disease prediction: A review. *Egyptian Informatics Journal*, 19(3), 179-189. <https://doi.org/10.1016/j.eij.2018.03.002>