University of Westminster
Trends in Computer Science
4COSC008C

Machine Learning

<u>Overview of Machine Learning. Describe and compare two different machine learning techniques.</u>

Student Name: Lagamuwalage Thinula Nethaka Harischandra
UOW Number: W2051872
IIT Number: 20231158
Group Number: G5-2

Name	UOW Number	IIT Student Number
R A Dhalley	W2051859	20231143
L T N Harischandra	W2051872	20231158
D A Y Abeywardena	W2051887	20231183
G A L C Perera	W2051869	20231153

Table of Contents

List of Figures

1. INTRODUCTION

Machine learning is a part of Artificial intelligence which can be used to analyze data, recognize patterns, and make predictions based on the data provided. Machine learning involves training models using vast amounts of data which can be used to make predictions by identifying the patterns of the provided data.

There are various types of machine-learning approaches including supervised learning, unsupervised learning, and reinforcement learning. Supervised learning deals with labelled data while unsupervised learning deals with unlabeled data.

Various industries used machine learning to ease their tasks including health care, finance, marketing, and more. Machine learning can be used to develop recommendation systems based on the pattern recognised from the previous data. Natural language processing is another use of machine learning. Image recognition and autonomous vehicles are also applications of machine learning.

2. OVERVIEW OF MACHINE LEARNING

Machine learning is an evolving branch of Artificial intelligence in which computers can make accurate predictions on their own. ML gives computers the ability to learn and improve about a specific field without direct programming. El Naqa and Murphy state that "Machine Learning is designed to emulate human intelligence by learning from the surrounding environment" (2015, p03).

2.1. Applications of machine learning

Machine learning has a wide range of uses in various fields. Examples of some fields that use machine learning are finance, healthcare, astronomy, climate science, transportation, and agriculture.

Applications that employ machine learning includes,

- Personalised feed on social media
- Email spam filters
- Virtual assistants use ML to generate responses and understand voice commands
- Translation tools using ML to increase the accurate
- Product recommendation
- GPS navigation apps use ML to select the fastest route.

2.2. Types of Machine Learning

According to Zhang (2010), the following are the main learning types of ML.

- Supervised Learning
- Unsupervised Learning
- Semi-Supervised Learning
- Reinforcement Learning
- Transduction
- Learning to Learn

3. SUPERVISED LEARNING

3.1. What is supervised learning?

Supervised learning, a fundamental Machine Learning type, uses labelled data sets of inputs and outputs given by the user for algorithm training. As the amount of data set increases, the accuracy of the model also increases.

This is the most heavily explored type of machine learning and the most common type found in commercial applications, such as those described in *Table 1* the supervised learning task is to learn some general function f(x)=y from a set of training examples of input - output (x,y) pairs of the function (Brynjolfsson and Mitchell, 2017).

Input X	Output Y	Application
Voice recording	Text transcript	Speech recognition
Historical market data	Future market data	Trading bots
Drug chemical properties	Treatment efficacy	Pharma R&D
Photograph	Tag	Image tagging
Store transaction details	Is the transaction fraudulent?	Fraud detection
Recipe ingredients	Customer review	Food recommendation
Purchase histories	Future purchase behaviours	Customer retention

Table 1: Set of training examples of input-output (x, y) pairs (Brynjolfsson and Mitchell, 2017).

3.2. Types of supervised learning

Regression and **classification** are the main types of supervised learning. **Regression** use an algorithm to understand the relationship between dependent and independent variables. Regression models are helpful for predicting numerical values based on different data points, such as sales revenue projections for a given business. Some popular regression algorithms are linear regression, logistic regression, and polynomial regression (Saini, 2021). **Classification** use an algorithm to accurately assign test data into specific categories, such as separating apples from oranges. Or, in the real world, supervised learning algorithms can be used to classify spam in a separate folder from your inbox. Linear classifiers, support vector machines, decision trees and random forests are all common types of classification algorithms (Saini, 2021).

4. UNSUPERVISED LEARNING

4.1. What is unsupervised learning?

Unsupervised learning is where you only have input data (X) and no corresponding output variables. The goal of unsupervised learning is to model the underlying structure or distribution in the data in order to learn more about data. These are called unsupervised learning because unlike supervised learning there are no correct answers and there is no teacher. Algorithms are left to their own devices to discover and present an interesting structure in the data (Iorkaa et al., 2021).

4.2. Types of unsupervised learning

According to Naeem et al. (2023) clustering, association, anomaly detection, and autoencoder issues are the four types of unsupervised learning.

- Clustering: The practice of classifying items into groups is known as clustering or clustering analysis (Naeem et al., 2023).
- Association: The unsupervised learning approach of Association Rule Learning is used to uncover associations between variables in massive datasets (Naeem et al., 2023).
- Anomaly detection: Any procedure that discovers outliers in a data set is known as anomaly detection (Naeem et al., 2023).
- Autoencoders: Autoencoders are an unsupervised learning approach that uses neural networks to do representation learning (Naeem et al., 2023).

5. COMPARING SUPERVISED LEARNING AND UNSUPERVISED LEARNING

	Supervised Machine Learning	**Unsupervised Machine Learning**
Labeled data	Requires labeled data	Uses unlabeled data
Data set	Data set contains input (x) and output data (y)	Only have input data (x)
Learning goals	Learns a mapping between input and output pair and enables prediction on unseen data.	Discovers hidden patterns and structures within the data.
Types	Classification, Regression	Clustering, Association, Anomaly detection
Accurate	More accurate	Less accurate
Training time	Time-consuming to train	Less time-consuming to train
Uses	Spam Filtering, Fraud detection, Machine translation	Market segmentation, Music recommendation, anomaly detection

Table 2: Supervised Learning vs Unsupervised Learning

6. CRITICAL EVALUATION

This report equipped the reader with a foundational understanding of machine learning concepts and applications. In this report, the author discussed supervised learning and unsupervised learning but there are many new advanced learning technologies like Self-supervised learning, Federated learning, Meta-learning, and Neuro-inspired learning.

7. CONCLUSION

In conclusion, machine learning involves different fields and that improves the productivity of individuals. Two machine learning techniques mentioned earlier supervised learning and unsupervised learning both have their advantages and disadvantages. The developer of the program needs to select the best type according to the particular use case and the environment.

REFERENCES

Bell, J. (2020). *Machine Learning: Hands-On for Developers and Technical Professionals*. [online] *Google Books*. John Wiley & Sons. Available at: https://books.google.lk/books?hl=en&lr=&id=-p_ODwAAQBAJ&oi=fnd&pg=PR27&dq=Introduction+to+Machine+Learning+(A+gentle+approach+%E2%80%93+no+maths [Accessed 10 Feb. 2024].

Brynjolfsson, E. and Mitchell, T. (2017). What Can Machine Learning Do? Workforce Implications. *Science*, 358(6370), pp.1530–1534. doi:https://doi.org/10.1126/science.aap8062.

Iorkaa, A., Barma, M., Gaya Muazu, H., Asongo, A. and Barma (2021). Machine Learning Techniques, methods and Algorithms: Conceptual and Practical Insights Machine Learning Techniques, methods and Algorithms: Conceptual and Practical Insights. *International Journal of Engineering Research and Applications www.ijera.com*, 11, pp.55–64. doi:https://doi.org/10.9790/9622-1108025564.

Issam, E.N. and Murphy, M.J. (2015). What is machine learning? In: El Naqa, Issam, R. Li and M.J. Murphy, eds. [online] Springer International Publishing, pp.3–11. doi:https://doi.org/10.1007/978-3-319-18305-3%E2%82%81.

Naeem, S., Ali, A., Anam, S. and Ahmed, M.M. (2023). An Unsupervised Machine Learning Algorithms: Comprehensive Review. *International Journal of Computing and Digital Systems*, 13(1), pp.911–921. doi:https://doi.org/10.12785/ijcds/130172.

Saini, S. (2021). *Supervised vs. Unsupervised Learning: What's the Difference?* [online] www.linkedin.com. Available at: https://www.linkedin.com/pulse/supervised-vs-unsupervised-learning-whats-difference-smriti-saini/.

Zhang, Y. (2010). *New Advances in Machine Learning.* [online] InTech. Available at: https://books.google.lk/books?id=XAqhDwAAQBAJ&lpg=PA19&ots=r3FpbYFiPr&dq=machine%20learning%20types&lr&pg=PA1#v=onepage&q=machine%20learning%20types&f=false [Accessed 9 Feb. 2024].