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1 UNIVERSITY OF WESTMINSTER

2 Trends in Computer Science

4COSC008C

Machine Learning

2 Overview of Machine Learning. 3 Describe and compare

two different machine learning techniques

Student Name: Lagamuwalage Thinula Nethaka Harischandra

UOW Number: W2051872

IIT Number: 20231158

Group Number: G5-2

4 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

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II

1 INTRODUCTION

12 Artificial intelligence includes machine learning, a Statistical analysis tool, that recognizes

patterns and makes 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 (Bell, 2020).

There are several kinds of machine-learning methodologies, including reinforcement learning, unsupervised learning, and supervised 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 recognized from the previous data. Image recognition and autonomous vehicles are also applications of machine learning.

1

2 OVERVIEW OF MACHINE LEARNING

Machine learning is a part of Artificial Intelligence that can be used to do their own accurate predictions. Machine learning gives computers the ability to learn and improve about a specific field without direct programming. El Naqa and Murphy (2015) state that “Machine Learning is designed to emulate human intelligence by learning from the surrounding environment”.

2.1 Practical Uses 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 include,

- 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 Categories of Machine Learning

According to Zhang (2010), Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning, and Learn to Learn are the main learning types of ML.

2

3 SUPERVISED LEARNING

3.1 Definition of supervised learning

Supervised learning, a fundamental Machine Learning type, uses labeled data sets of inputs and

outputs the user gives for algorithm training. As the amount of data set increases, the model's accuracy also increases.

Supervised learning is the most researched kind of machine learning type. The goal of supervised learning is to learn a generic function f(x)=y from a series of training examples of input-output (x,y) pairs of the function, such those shown in Table 3.1 (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 3.1: Set of training examples of input-output (x, y) pairs (Brynjolfsson and Mitchell, 2017)

3.2 Categories of supervised learning

There are two main types of supervised learning Regression and Classification. An algorithm is used by the Regression to understand the relationship between the dependent and the independent variables. Logistic regression, linear regression, and polynomial regression can be defined as some regression algorithms. They can be used to predict numerical values (Nasteski, 2017).

To accurately classify test data into distinct categories, the classification uses an algorithm. As an example, in practice, spam can be categorized using supervised learning algorithms and placed in a different folder from the inbox. Common classification algorithm types include decision trees, support vector machines, and linear classifiers (Nasteski, 2017).

3

4 UNSUPERVISED LEARNING

4.1 Definition of unsupervised learning

Only input data (x) and no matching output variables are available in unsupervised learning.

The goal of unsupervised learning is to model the underlying structure or distribution in the data 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 can use their own devices to discover and present an interesting structure in the data (Abraham Iorkaa et al., 2021).

4.2 Categories of unsupervised learning

(22) According to Naeem et al. (23) (2023) clustering, association, anomaly detection, and autoencoder

(17) 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).

4

(10) 5 EXAMINING SUPERVISED VS UNSUPERVISED LEARNING

Supervised ML	Unsupervised ML
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	Learning a mapping between input and output pair and enables prediction on unseen data.	Discovers hidden patterns (4) and structures within the data
Types	Classification, Regression	Clustering, Association, Anomaly detection
(10) Accurate	More accurate	Less accurate
Training time	Higher time-consuming	Less time-consuming
Uses	Spam Filtering, Fraud detection, Machine translation	Market segmentation, Music recommendation, Outlier detection

(24) Table 5.1: (11) Contrasting Supervised and Unsupervised Learning

5

6 CRITICAL EVALUATION

This report equipped the reader with a foundational understanding of machine learning concepts and applications. (11) 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.

6

7 CONCLUSION

In conclusion, machine learning involves different fields, and that improves the productivity of individuals. (4) Two machine learning techniques including supervised learning and unsupervised learning within the above chapters, have both pros and cons. The developer of the program needs to select the best type according to the particular use case and the environment.

7

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UNSUPERVISED LEARNING Definition of unsupervised learning Categories of unsupervised learning

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unsupervised learning, and supervised learning.	supervised learning and unsupervised learning
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while unsupervised learning deals with unlabeled data.	Unsupervised learning algorithms can work with unlabeled data but
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Machine learning can be used to develop recommendation systems based	be used to develop machine learning
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are also applications of machine learning.	There are many applications for machine learning, including
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2 OVERVIEW OF MACHINE LEARNING	Figure-2 Overview of Machine Learning
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Machine learning gives computers the ability to learn and improve about a specific	• Machine Learning gives computers the ability to learn from experiences
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designed to emulate human intelligence by learning from the surrounding environment".	emulate human intelligence by learning from the surrounding environment

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There are two main types of supervised learning Regression and Classification.	There are two main types of supervised learning
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used by the Regression to understand the relationship between the dependent and the independent	Regression is used to understand the relationship between dependent and independent

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Logistic regression, linear regression, and polynomial regression can be defined as	These methods include logistic regression, linear regression, and polynomial regression
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To accurately classify test data into distinct categories, the classification uses an algorithm.	An algorithm is used to accurately assign test data into specific categories
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an example, in practice, spam can be categorized using supervised learning algorithms and	In the real life, spam may be categorized using supervised learning
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decision trees, support vector machines, and linear classifiers (Nasteski, 2017).	of classification algorithms are decision trees, support vector machines, linear classifiers, and
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4.1 Definition of unsupervised learning	2.4.1.2 Unsupervised learning
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Only input data (x) and no matching output variables are available in unsupervised learning.	where you only have input data (X) and no corresponding output variables
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The goal of unsupervised learning is to model the underlying structure or distribution in the data	The goal for unsupervised learning is to model the underlying structure or distribution in the data to learn more about the data
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These are called unsupervised learning because unlike supervised learning there are no correct answers and there is no teacher.	These are called unsupervised learning because unlike supervised learning above there is no correct answers and there is no teacher These are called unsupervised learning because unlike supervised learning above there is no correct answers and there is no teacher

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