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Trends in Computer Science
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Machine Learning

Overview of Machine Learning. Describe and compare two different machine learning techniques.

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1. INTRODUCTION

Artificial intelligence includes machine learning, which is a tool for data analysis, 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 several kinds of machine-learning methodologies, such as 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 recognised from the previous data. Image recognition and autonomous vehicles are also applications of machine learning.

2. OVERVIEW OF MACHINE LEARNING

Machine learning is a part of Artificial Intelligence which 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 state that "Machine Learning is designed to emulate human intelligence by learning from the surrounding environment" (2015, p03).

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 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. Categories 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. Definition of 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. Categories of supervised learning

There are two main types of supervised learning which are called as Regression and Classification.

An algorithm is used by the Regression to understand the relationship between 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, like apples and oranges, classification uses an algorithm. Alternatively, in practice, spam can be categorized using supervised learning algorithms and placed in a different folder from the inbox. Common

classification algorithm types include random forests, decision trees, support vector machines, and linear classifiers (Nasteski, 2017).

4. UNSUPERVISED LEARNING

4.1. Definition of 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. Categories 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. HIGHLIGHTING THE DIFFERENCE BETWEEN SUPERVISED 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	Higher time-consuming	Less time-consuming
Uses	Spam Filtering, Fraud detection, Machine translation	Market segmentation, Music recommendation, Outlier detection

Table 2: Contrasting Supervised and 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 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.

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