

Types of Machine Learning



1. Supervised Machine Learning
2. Unsupervised Machine Learning
3. Semi-Supervised Machine Learning
4. Reinforcement Learning

Supervised Machine Learning

- Supervised learning involves training an algorithm using labeled data.
- In pointwise learning, each data point is treated in isolation for prediction.
- It is used for both classification and regression tasks.
- Each data point is considered independently, without considering relationships between them.
- Common applications include sentiment analysis and recommendation systems.
- Pointwise methods are suitable for ranking problems, like search result ranking.
- They are scalable and can handle large datasets effectively.
- Effective feature engineering is crucial for pointwise models' performance.
- Task-specific loss functions are used, like cross-entropy for classification.
- Evaluation metrics vary by task, e.g., accuracy for classification and mean squared error for regression.

Categories of Supervised Machine Learning

Supervised machine learning can be classified into two types of problems, which are given below:

- Classification
- Regression

a) Classification

- Classification algorithms are used to solve the classification problems.
- the output variable is categorical, such as “Yes” or No, Male or Female, Red or Blue, etc.
- The classification algorithms predict the categories present in the dataset.
- Some real-world examples of classification algorithms are Spam Detection, Email filtering, etc.

Some popular classification algorithms are given below:

- Random Forest Algorithm
- Decision Tree Algorithm
- Logistic Regression Algorithm
- Support Vector Machine Algorithm

b) Regression

- Regression algorithms are used to solve regression problems.
- there is a linear relationship between input and output variables.
- These are used to predict continuous output variables, such as market trends, weather predictions, etc.

Some popular Regression algorithms are given below:

- Simple Linear Regression Algorithm
- Multivariate Regression Algorithm
- Decision Tree Algorithm
- Lasso Regression

Advantages and Disadvantages of Supervised Learning

Advantages:

- Since supervised learning work with the labeled dataset so we can have an exact idea about the classes of objects.
- These algorithms are helpful in predicting the output on the basis of prior experience.

Disadvantages:

- These algorithms are not able to solve complex tasks.
- It may predict the wrong output if the test data is different from the training data.
- It requires lots of computational time to train the algorithm.

Applications of Supervised Learning

- Image classification.
- Spam email detection.
- Credit risk assessment.
- Autonomous vehicle navigation.
- Speech recognition.
- Language translation.
- Healthcare diagnosis.
- Fraud detection.

Unsupervised Machine Learning

- No need for labeled data.
- Models work with unclassified and unlabeled data.
- Main goal is to group data based on similarities.
- Uncover hidden patterns and differences in data.
- No predefined output categories.
- Common techniques include clustering and dimensionality reduction.
- Used for anomaly detection.
- Suitable for customer segmentation and data exploration.
- Machines self-organize data.
- Applications include recommendation systems.

Categories of Unsupervised Machine Learning

Unsupervised Learning can be further classified into two types, which are given below:

- **Clustering**
- **Association**

Clustering

- The clustering technique is used when we want to find the inherent groups from the data.
- It is a way to group the objects into a cluster such that the objects with the most similarities remain in one group and have fewer or no similarities with the objects of other groups.
- An example of the clustering algorithm is grouping the customers by their purchasing behaviour.

Some of the popular clustering algorithms are given below:

- K-Means Clustering algorithm
- Mean-shift algorithm
- DBSCAN Algorithm
- [Principal Component Analysis](#)
- Independent Component Analysis

Association

- Association rule learning is an unsupervised learning technique,
- It finds interesting relations among variables within a large dataset.
- The main aim of this learning algorithm is to find the dependency of one data item on another data item and map those variables accordingly so that it can generate maximum profit.
- This algorithm is mainly applied in Market Basket Analysis. Web usage mining, continuous production, etc.
- Some popular algorithms of Association rule learning are Apriori Algorithm, Eclat, FP-growth algorithm.

Advantages and Disadvantages of Unsupervised Learning Algorithm

Advantages:

- These algorithms can be used for complicated tasks compared to the supervised ones because these algorithms work on the unlabeled dataset.
- Unsupervised algorithms are preferable for various tasks as getting the unlabeled dataset is easier as compared to the labelled dataset.

Disadvantages:

- The output of an unsupervised algorithm can be less accurate as the dataset is not labelled, and algorithms are not trained with the exact output in prior.
- Working with Unsupervised learning is more difficult as it works with the unlabelled dataset that does not map with the output.

Applications of Unsupervised Learning

- Clustering customer segments.
- Anomaly detection in cybersecurity.
- Topic modeling in natural language processing.
- Dimensionality reduction for data compression.
- Image and video compression.
- Identifying patterns in stock market data.
- Recommender systems for product recommendations.
- Grouping news articles by similarity.

Reinforcement Learning

- Feedback-based learning with trial and error.
- No labeled data; learning from experiences.
- Resembles human learning through experiences.
- Commonly used in gaming and high-score achievement.
- Applied in Game Theory, Operations Research, Information Theory, and Multi-Agent Systems.
- Formalized using Markov Decision Processes (MDP).

Applications of Reinforcement Learning

- Game playing, like AlphaGo.
- Robotics control and automation.
- Self-driving cars.
- Healthcare treatment optimization.
- Recommendation systems.
- Financial trading.
- Energy management.
- Natural language processing.

Advantages and Disadvantages of Reinforcement Learning

Advantages

- It helps in solving complex real-world problems which are difficult to be solved by general techniques.
- The learning model of RL is similar to the learning of human beings; hence most accurate results can be found.
- Helps in achieving long-term results.

Disadvantage

- RL algorithms are not preferred for simple problems.
- RL algorithms require huge data and computations.
- Too much reinforcement learning can lead to an overload of states which can weaken the results.

The curse of dimensionality limits reinforcement learning for real physical systems.

Comparison between Supervised, Unsupervised, Reinforcement and Deep Learning

Criteria	Supervised ML	Unsupervised ML	Reinforcement ML	Deep Learning
Definition	Learns by using labelled data	Trained using unlabelled data without any guidance.	Works on interacting with the environment	Based on artificial neural networks. Can be supervised, semi-supervised or unsupervised.
Type of data	Labelled data	Unlabelled data	No – predefined data	Labelled or unlabelled data
Type of problems	Regression and classification	Association and Clustering	Exploitation or Exploration	computer vision, speech recognition, machine translation, bioinformatics etc.
Algorithms	Linear Regression, Logistic Regression, SVM, KNN etc.	K – Means, C – Means, Apriori	Q – Learning, SARSA	Artificial neural network (ANN)
Application	Risk Evaluation, text classification, image classification, Forecast Sales	Recommendation System, Anomaly Detection	Self Driving Cars, Gaming, Healthcare	Self-driving cars, speech recognition, bioinformatics, medical image analysis etc.