DAY – 3

31 July 2025

Machine Learning (ML) is a subset of Artificial Intelligence (AI) that teaches computers to learn from data and improve performance on tasks without being explicitly programmed for every scenario, using algorithms to find patterns and make predictions. It involves training models on large datasets to recognize insights, allowing them to make decisions or generate new content, powering everything from recommendation engines to autonomous vehicles. The main types include Supervised (labelled data), Unsupervised (unlabelled data patterns), and Reinforcement Learning (trial-and-error rewards).

Machine Learning is mainly divided into three core types: Supervised, Unsupervised and Reinforcement Learning along with two additional types, Semi-Supervised and Self-Supervised Learning.

- Supervised Learning: Trains models on labeled data to predict or classify new, unseen data.
- Unsupervised Learning: Finds patterns or groups in unlabeled data, like clustering or dimensionality reduction.
- Reinforcement Learning: Learns through trial and error to maximize rewards, ideal for decision-making tasks.

Supervised Learning

Supervised learning algorithms are generally categorized into two main types:

- **Classification** - where the goal is to predict discrete labels or categories
- **Regression** - where the aim is to predict continuous numerical values.

There are many algorithms used in supervised learning each suited to different types of problems. Some of the most commonly used supervised learning algorithms are:

1. Linear Regression

This is one of the simplest ways to predict numbers using a straight line. It helps find the relationship between input and output.

- Introduction to Linear Regression
- Gradient Descent in Linear Regression
- Multiple Linear Regressions

2. Logistic Regression

Used when the output is a "yes or no" type answer. It helps in predicting categories like pass/fail or spam/not spam.

- Understanding Logistic Regression
- Cost function in Logistic Regression

3. Decision Trees

A model that makes decisions by asking a series of simple questions, like a flowchart. Easy to understand and use.

- Decision Tree in Machine Learning
- Types of Decision tree algorithms
- Decision Tree - Regression (Implementation)
- Decision tree - Classification (Implementation)

4. Support Vector Machines (SVM)

A bit more advanced—it tries to draw the best line (or boundary) to separate different categories of data.

- Understanding SVMs
- SVM Hyperparameter Tuning - GridSearchCV
- Non-Linear SVM

5. k-Nearest Neighbors (k-NN)

This model looks at the closest data points (neighbors) to make predictions. Super simple and based on similarity.

- Introduction to KNN
- Decision Boundaries in K-Nearest Neighbors (KNN)

6. Naïve Bayes

A quick and smart way to classify things based on probability. It works well for text and spam detection.

- Introduction to Naive Bayes
- Gaussian Naive Bayes
- Multinomial Naive Bayes
- Bernoulli Naive Bayes
- Complement Naive Bayes

7. Random Forest

A powerful model that builds lots of decision trees and combines them for better accuracy and stability.

- Introduction to Random forest
- Random Forest Classifier
- Random Forest Regression
- Hyper parameter Tuning in Random Forest

Unsupervised learning

Unsupervised learning are again divided into three main categories based on their purpose:

- Clustering
- Association Rule Mining
- Dimensionality Reduction

1. Clustering

Clustering algorithms group data points into clusters based on their similarities or differences. Types of clustering algorithms are:

Centroid-based Methods:

- K-Means clustering
- Elbow Method for optimal value of k in KMeans
- K-Means++ clustering
- K-Mode clustering
- Fuzzy C-Means (FCM) Clustering

Distribution-based Methods:

- Gaussian mixture models
- Expectation-Maximization Algorithm
- Dirichlet process mixture models (DPMMs)

Connectivity based methods:

- Hierarchical clustering
- Agglomerative Clustering
- Divisive clustering
- Affinity propagation

Density Based methods:

- DBSCAN (Density-Based Spatial Clustering of Applications with Noise)
- OPTICS (Ordering Points To Identify the Clustering Structure)

2. Dimensionality Reduction

Dimensionality reduction is used to simplify datasets by reducing the number of features while retaining the most important information.

- Principal Component Analysis (PCA)
- t-distributed Stochastic Neighbor Embedding (t-SNE)
- Non-negative Matrix Factorization (NMF)
- Independent Component Analysis (ICA)
- Isomap
- Locally Linear Embedding (LLE)

3. Association Rule

Find patterns between items in large datasets typically in market basket analysis.

- Apriori algorithm
- Implementing apriori algorithm
- FP-Growth (Frequent Pattern-Growth)
- ECLAT (Equivalence Class Clustering and bottom-up Lattice Traversal)

Reinforcement Learning

Reinforcement learning interacts with environment and learn from them based on rewards.

1. Model-Based Methods

These methods use a model of the environment to predict outcomes and help the agent plan actions by simulating potential results.

- Markov decision processes (MDPs)
- Bellman equation
- Value iteration algorithm
- Monte Carlo Tree Search

2. Model-Free Methods

The agent learns directly from experience by interacting with the environment and adjusting its actions based on feedback.

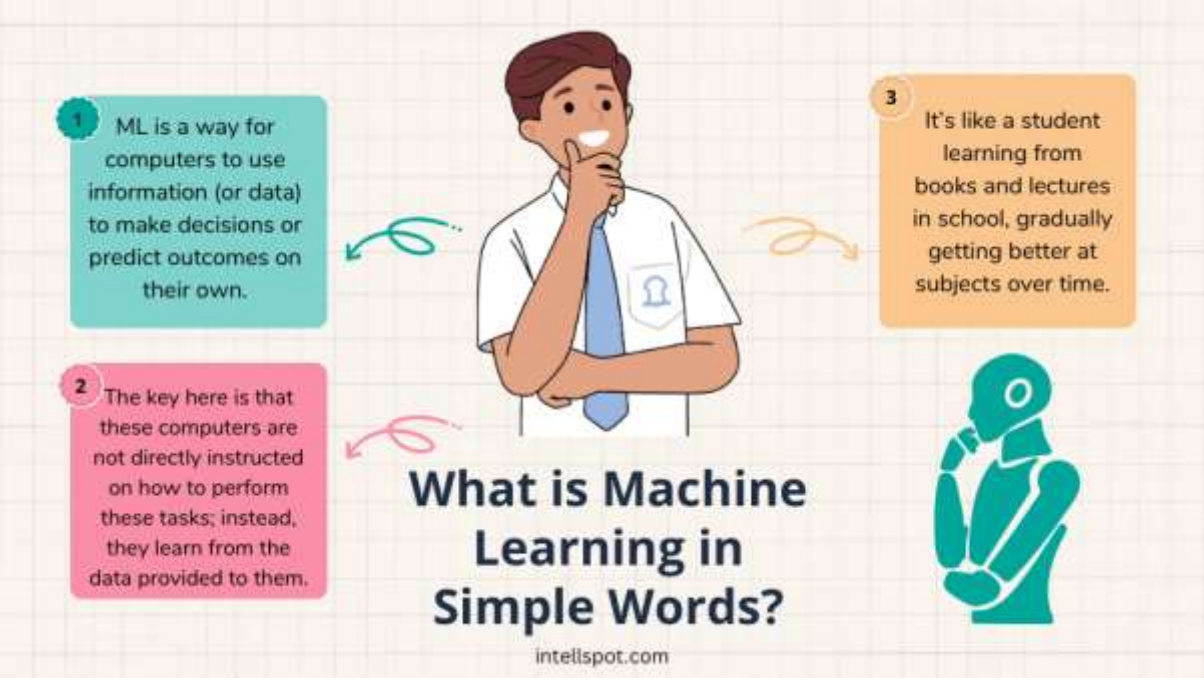
- Q-Learning
- SARSA
- Monte Carlo Methods
- Reinforce Algorithm
- Actor-Critic Algorithm
- Asynchronous Advantage Actor-Critic (A3C)

Real-World Application of Machine Learning

Here are some specific areas where machine learning is being used:

- **Predictive modelling:** Machine learning can be used to build predictive models that can help businesses make better decisions. For example, machine learning can be used to predict which customers are most likely to buy a particular product, or which patients are most likely to develop a certain disease.
- **Natural language processing:** Machine learning is used to build systems that can understand and interpret human language. This is important for applications such as voice recognition, chatbots, and language translation.
- **Computer vision:** Machine learning is used to build systems that can recognize and interpret images and videos. This is important for applications such as self-driving cars, surveillance systems, and medical imaging.
- **Fraud detection:** Machine learning can be used to detect fraudulent behavior in financial transactions, online advertising, and other areas.
- **Recommendation systems:** Machine learning can be used to build recommendation systems that suggest products, services, or content to users based on their past behaviour and preferences.

Overall, machine learning has become an essential tool for many businesses and industries, as it enables them to make better use of data, improve their decision-making processes, and deliver more personalized experiences to their customers.


1
ML is a way for computers to use information (or data) to make decisions or predict outcomes on their own.
2
The key here is that these computers are not directly instructed on how to perform these tasks; instead, they learn from the data provided to them.
3
It's like a student learning from books and lectures in school, gradually getting better at subjects over time.
What is Machine Learning in Simple Words?
intellspot.com