

Machine Learning

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① What is Machine Learning?

② Summary

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What is Machine Learning

- Tom M. Mitchell defines machine learning in his book "Machine Learning" (1997) with a widely accepted and clear definition:
- A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T , as measured by P , improves with experience E .

- Breaking Down the Definition:
- Task (T): The specific activity the program is designed to perform (e.g., recognizing handwritten digits, recommending movies, or cancer detection).
- Experience (E): The data or interactions that the program is exposed to during training.
- Performance Measure (P): A quantitative metric to evaluate how well the program performs the task.

1 What is Machine Learning?

2 Summary

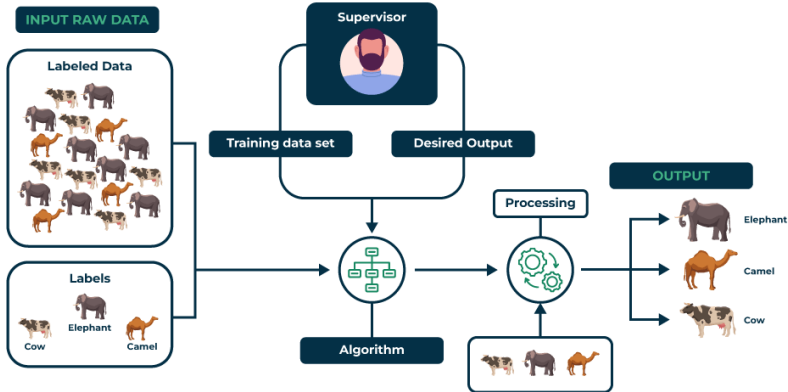
Supervised Learning

- In supervised learning, the model learns from labeled data, where each input (feature) is paired with a corresponding output (label or target). The goal is to learn a mapping from inputs to outputs.
- In other words, we provide the computer with the problem and its solution, enabling it to discover answers for unsolved problems.

Supervised Learning Example

- **Regression:** Predict continuous values (e.g., house prices, temperature).
- **Classification:** Predict discrete categories (Heart Disease Detection, Classifying the risk level of cardiovascular diseases using patient vitals and medical history)

Supervised Learning



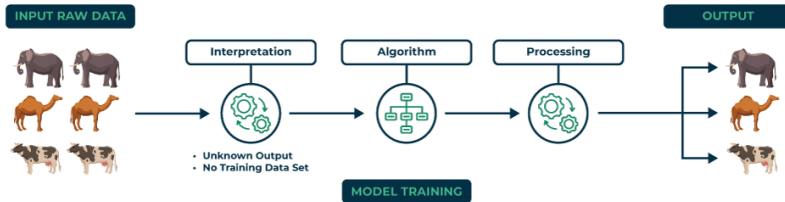
Unsupervised Learning

- In unsupervised learning, the model learns patterns or structures from data without labeled outputs. It is used to uncover hidden patterns or groupings.

Unsupervised Learning Example

- **Clustering:** Group similar data points (e.g., customer segmentation).
- Algorithms: K-Means, DBSCAN, Hierarchical Clustering.

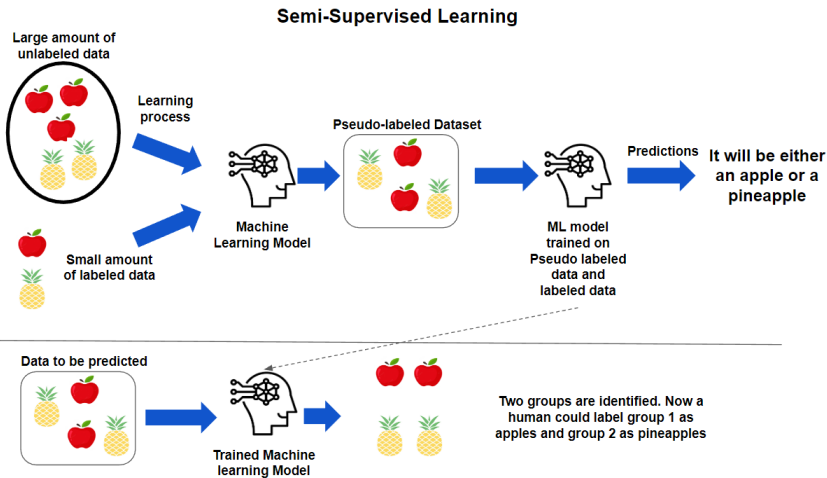
Unsupervised Learning



Semi-Supervised Learning

- Semi-supervised learning combines elements of supervised and unsupervised learning. It uses a small amount of labeled data and a large amount of unlabeled data to improve learning.
- Example : Image recognition tasks with few labeled images and many unlabeled images.

Semi-Supervised Learning



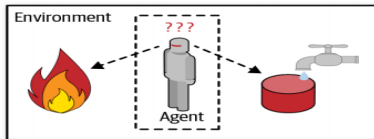
Reinforcement Learning

- Reinforcement learning (RL) involves learning by interacting with an environment to achieve a goal. The model (agent) learns to take actions that maximize cumulative rewards.
- Example : Robotics, game playing (e.g., AlphaGo), autonomous vehicles.

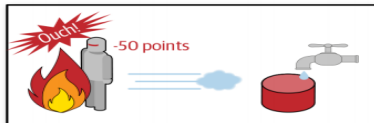
Reinforcement Learning Components

- Agent: The learner or decision-maker.
- Environment: The system the agent interacts with.
- Policy: A strategy that maps states to actions.
- Reward Signal: Feedback to guide learning.

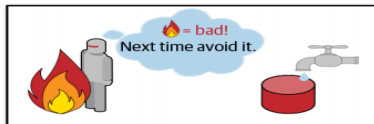
Reinforcement Learning



- 1 Observe
- 2 Select action using policy



- 3 Action!
- 4 Get reward or penalty



- 5 Update policy (learning step)
- 6 Iterate until an optimal policy is found

Types of Machine Learning

Type	Input	Output	Example Tasks
Supervised Learning	Labeled data	Predict labels or continuous values	Spam detection, house price prediction
Unsupervised Learning	Unlabeled data	Grouping or structure discovery	Customer segmentation, anomaly detection
Semi-Supervised Learning	Few labeled + many unlabeled data	Improved predictions using both	Medical image classification
Reinforcement Learning	Interactions + reward signal	Optimal policy for actions	Game playing, robotics

End of Preface