Quick Refresher for ML

Machine Learning Overview

Learning Objective

By the end of this lesson, you will be able to:

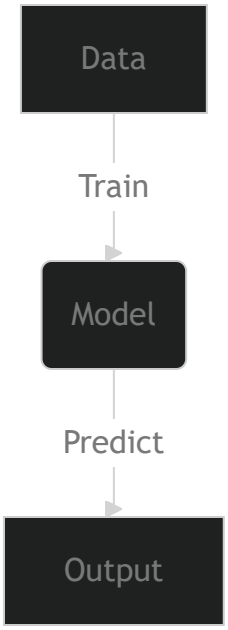
- Define machine learning.
- Explain the three primary types of machine learning: supervised, unsupervised, and reinforcement learning.
- Understand their core distinctions and common business applications.

What is Machine Learning?

Machine learning (ML) is a subset of artificial intelligence (AI) that enables systems to learn from data and make predictions or decisions without being explicitly programmed. Instead of writing specific rules for every possible outcome, ML systems identify patterns in data to generate insights and automate decision-making.

✅ **Traditional programming**: Rules + Data → Output

✅ **Machine learning**: Data + Output → Model (learned rules)



Types of Machine Learning

1. Supervised Learning

- The model is trained on labeled data, meaning the input data is paired with the correct output.
- The goal is to learn a mapping from inputs to outputs, enabling the model to predict outcomes for new data.

Common Algorithms: Linear Regression, Decision Trees, XGBoost

Business Applications:

- Predicting customer churn
- Credit scoring
- Demand forecasting
- Email spam detection

Key Distinction: There is a clear, known outcome (labeled data).

2. Unsupervised Learning

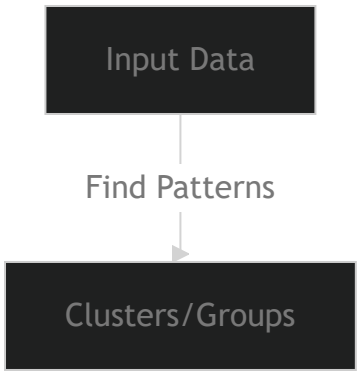
- The model is trained on unlabeled data. It identifies patterns, groupings, or structures without knowing the correct outputs.

Common Algorithms: K-Means Clustering, Principal Component Analysis (PCA)

Business Applications:

- Customer segmentation
- Anomaly detection (e.g., fraud detection)
- Market basket analysis (product recommendations based on purchase behavior)

Key Distinction: There is no predefined outcome; the goal is to uncover hidden patterns.



3. Reinforcement Learning

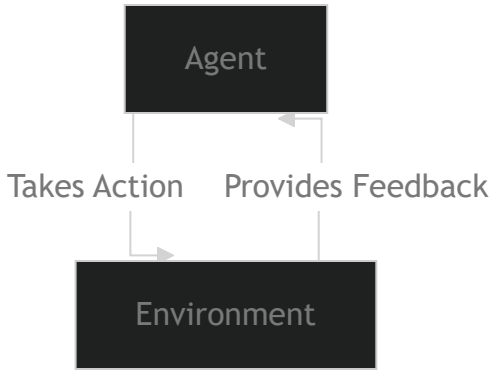
- The model learns through trial and error by interacting with an environment. It receives feedback in the form of rewards or penalties based on its actions.

Common Algorithms: Q-Learning, Policy-Based Methods

Business Applications:

- Robotics (e.g., autonomous vehicles, warehouse automation)
- Dynamic pricing
- Recommendation systems that adapt based on user behavior
- Game playing (e.g., AlphaGo)

Key Distinction: Learning occurs through actions and feedback from the environment, focusing on long-term rewards.



Summary Table

Type	Data Input	Goal	Example Application
Supervised Learning	Labeled data	Predict known outcomes	Predicting loan defaults
Unsupervised Learning	Unlabeled data	Identify patterns or groupings	Customer segmentation
Reinforcement Learning	Environment feedback	Maximize cumulative reward over time	Optimizing supply chain logistics

Key Takeaways for Business

- **Supervised Learning:** Best when you need predictions and have historical data with known outcomes.
- **Unsupervised Learning:** Useful when exploring data to discover hidden patterns or groupings.
- **Reinforcement Learning:** Ideal when making sequential decisions in dynamic environments

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