

Instance-Based vs Model-Based Machine Learning

Machine Learning algorithms can be broadly classified into **Instance-Based Learning** and **Model-Based Learning** based on how they learn and make predictions.

1 Instance-Based Machine Learning

Definition

Instance-Based Learning (also called **lazy learning**) stores the **training data** and makes predictions **only when a new instance is given**.

- ➡ No explicit training phase
- ➡ Learning happens at **prediction time**

How it Works

- Store all training examples
- When a new input comes:
 - Compare it with stored instances
 - Find the most similar ones
 - Predict based on similarity

Common Algorithms


- **K-Nearest Neighbors (KNN)**
- Locally Weighted Regression
- Case-Based Reasoning

Advantages

- Simple and easy to understand 😊

- No training time required
- Adapts well to complex data patterns

Disadvantages

- High memory usage (stores all data )
- Slow during prediction
- Sensitive to noisy and irrelevant features



Example

In **KNN**, to classify a new student as *pass/fail*, the algorithm:

- Finds the nearest students based on marks
- Assigns the class based on majority voting

Model-Based Machine Learning



Definition

Model-Based Learning builds a **generalized model** from training data and uses this model to make predictions.



Explicit **training phase**



Fast predictions after training



How it Works

- Learn patterns from training data
- Create a mathematical or logical model
- Use the model for future predictions



Common Algorithms

- Linear Regression
- Logistic Regression

- Decision Trees
- Naive Bayes
- Neural Networks

✓ Advantages

- Fast prediction 🚀
- Requires less memory
- Works well with large datasets

✗ Disadvantages

- Training can be time-consuming
- May not adapt well to new patterns
- Risk of underfitting or overfitting



Example

In **Linear Regression**, the model learns a line:

$$y = mx + c$$

and uses it to predict values for new inputs.



Key Differences (Exam Table)

Feature	Instance-Based Learning	Model-Based Learning
Learning Type	Lazy Learning	Eager Learning
Training Phase	No	Yes
Prediction Speed	Slow	Fast
Memory Usage	High	Low
Generalization	No explicit model	Uses a trained model
Examples	KNN	Regression, Decision Tree