What is Machine Learning?

Machine learning is a method of teaching computers to

* learn from data,
* find patterns,
* make decisions or predictions

without being explicitly programmed.

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Learns from** | **Output Type** | **Example** |
| Supervised | Labeled Data (X + Y) | Predict known output | Predict heart disease (Y/N) |
| Unsupervised | Unlabeled Data (x only) | Discover hidden patterns | Customer Segmentation |
| Reinforcement | Environment + Rewards | Learn by trial/error | Game AI, Robot Navigation |

Key terms:

Feature(X): An input variable (age, cholesterol)

Label/Target(Y): What we want to predict (heart disease= 1 or 0)

Model: A mathematical function that maps X 🡪 Y

Training: The process of teaching the model by feeding it data

Prediction: Using the model on new, unseen data to guess Y

Loss Function: A measure of how wrong the model’s predictions are.

Optimizer: A method to reduce the loss and improve the model.

Evaluation: Checking how well the model performs (accuracy, precision…)

Machine Learning Process (pipeline)

1. Understand the problem
2. Collect/Load Data
3. Explore/Clean
4. Feature Engineering
5. Split Data: Train/Test (normally 70/30)
6. Train Model (Logistic Regression)
7. Evaluate Model: Accuracy, Precision, Confusion Matrix
8. Deploy or Improve: Use it in real world OR improve accuracy

Performance Metrics:

Accuracy: % of correct predictions

Precision: How many predicted positives were actually correct

Recall: How many actual positives did we catch

F1-Score: Harmonic mean of Precision and Recall

Harmonic mean = (2 x P x R) / (P + R)

Example:

Point A 🡪 B : 60 km/h

Point B 🡪 A: 40 km/h

Confusion Matrix

|  |  |  |  |
| --- | --- | --- | --- |
| Patient | Actual | Predicted | What Happened |
| A | 1 | 1 | TP |
| B | 0 | 0 | TN |
| C | 1 | 0 | FN |
| D | 0 | 1 | FP |

| **Actual** | **Predicted** |  |  |
| --- | --- | --- | --- |
| 1 | 1 | TP |  |
| 1 | 0 | FN |  |
| 0 | 0 | TN |  |
| 0 | 1 | FP |  |
| 1 | 1 |  |  |

Email filtering AI

AI: 10 emails spam

Actually: 6 of them were truly spam

4 emails were wrongly marked as spam

Precision = TP / (TP + FP) = 6/10 = 660%

Recall= TP / (TP + FN) = 6/10 = 60%