Introduction: Machine Learning

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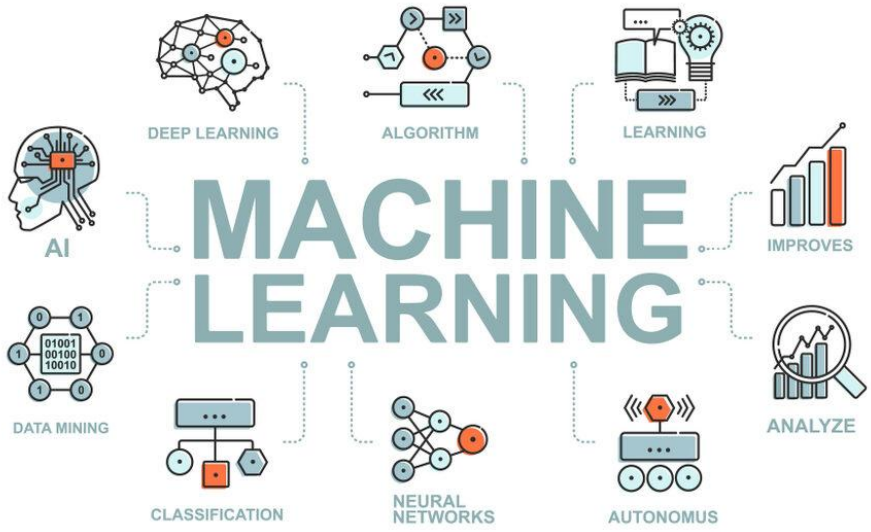
What is Machine Learning?



Machine Learning is a subset of Artificial Intelligence where **machines learn patterns from data** and make **predictions or decisions without being explicitly programmed**.

Simple line:

> *ML = Learn from data → Find patterns → Make predictions*

Why do we need Machine Learning?

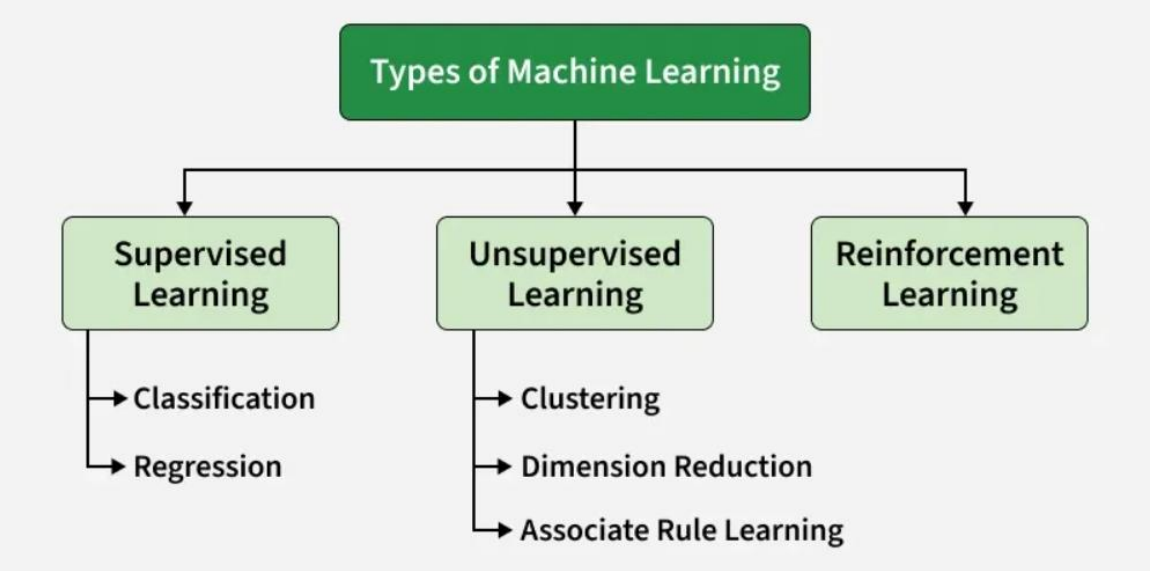
- Traditional programming fails when:
  - Rules are **too complex**
  - Data is **huge**
  - Patterns are **not obvious**
- ML is used when:
  - Data keeps changing
  - Decisions must improve over time

Examples

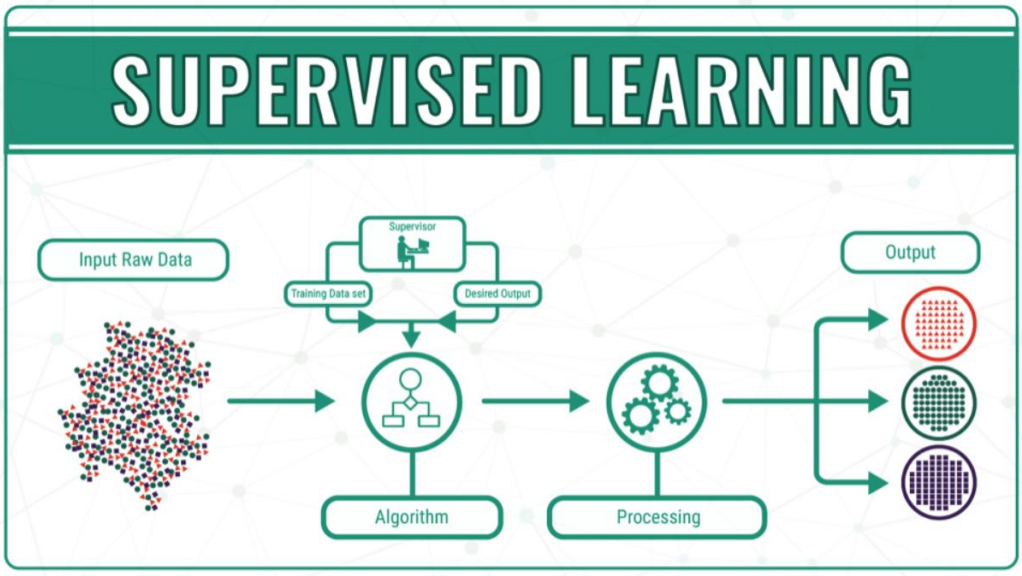
- Email spam detection

- Netflix recommendations
- Credit risk prediction
- Face recognition

Types of Machine Learning



Supervised Learning



Data is **labeled** (input + output known)

Structure

- Input features → Model → Output (label)

Used when:

- You know the **correct answer**
- You want **prediction**

Types

a) Regression (Continuous Output)

- Predicts numbers

Examples:

- House price
- Salary
- Sales forecasting

Common Algorithms:

- Linear Regression
- Polynomial Regression
- Ridge / Lasso
- Decision Tree Regressor
- Random Forest Regressor

b) Classification (Categorical Output)

- Predicts classes

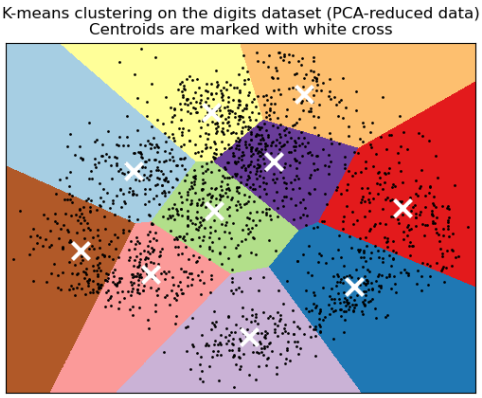
Examples:

- Spam / Not spam
- Disease: Yes / No
- Fraud detection

Common Algorithms:

- Logistic Regression
- KNN
- Decision Tree
- Random Forest
- SVM
- Naive Bayes

Unsupervised Learning



Data is **not labeled** (only inputs)

Used when:

- You don’t know the output
- You want to **find structure or groups**

Types

a) Clustering

Groups similar data points

Examples:

- Customer segmentation
- Grouping students
- Market analysis

Algorithms:

- K-Means
- Hierarchical Clustering
- DBSCAN

b) Dimensionality Reduction

Reduce features while keeping information

Examples:

- Data visualization
- Noise reduction

Algorithms:

- PCA
- SVD
- t-SNE

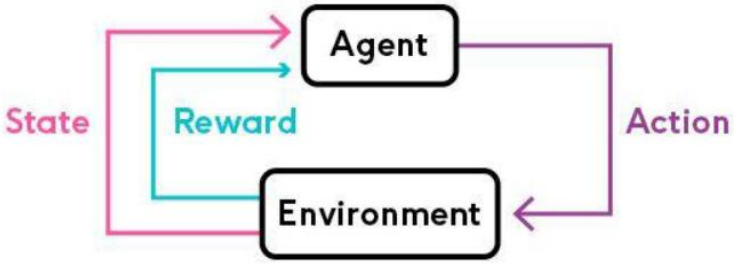
Semi-Supervised Learning

- **Few labeled + many unlabeled** data points

Example:

- Medical images (labeling is expensive)

Reinforcement Learning



- Learns by **trial and error**
- Uses **reward & penalty**

Key Terms:

- Agent
- Environment
- Action
- Reward
- Policy

Examples:

- Game AI
- Robotics
- Route optimization