Al-Mustaqbal University

College of Engineering & Technology

Biomedical Engineering Department

Subject Name: Selective

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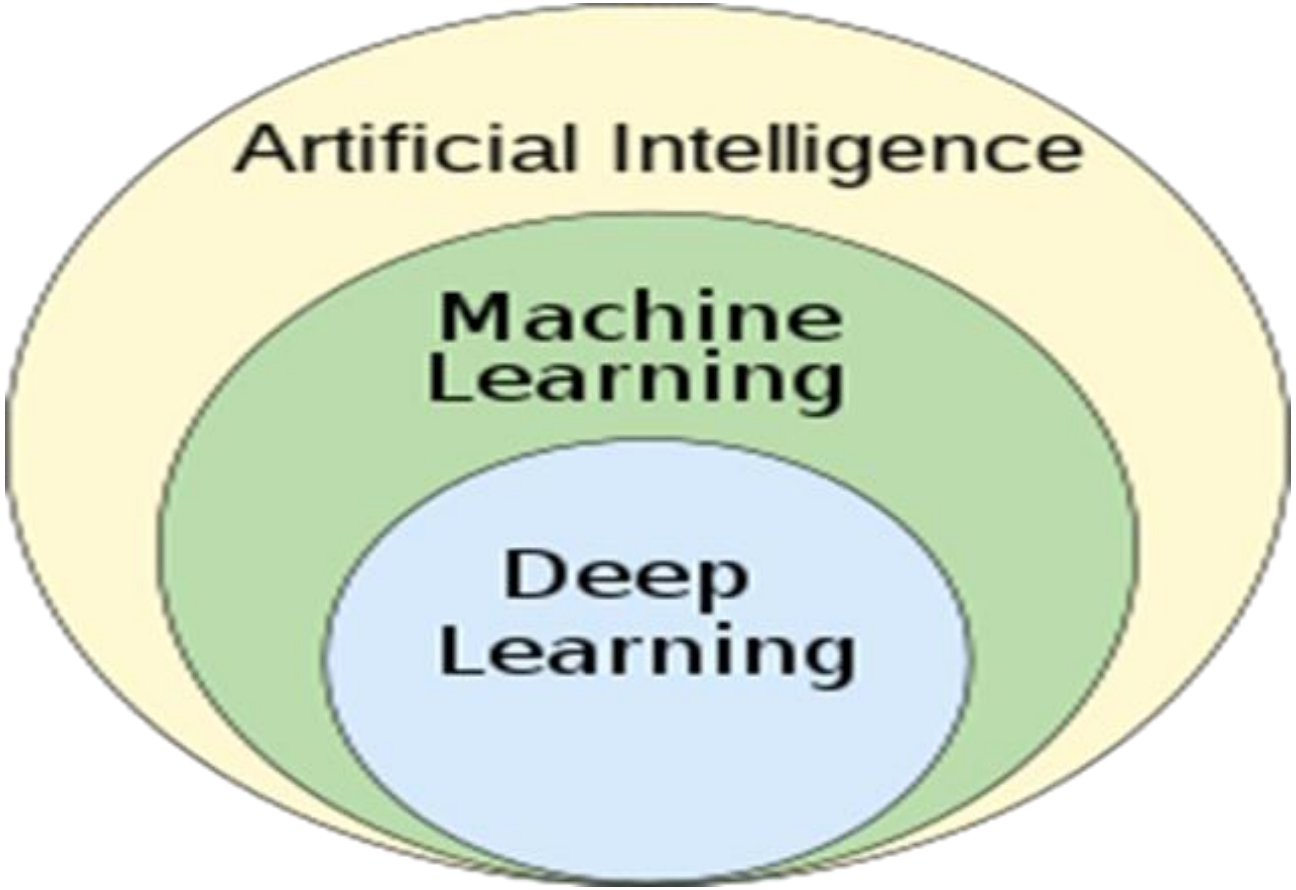
Lecture No.:-1

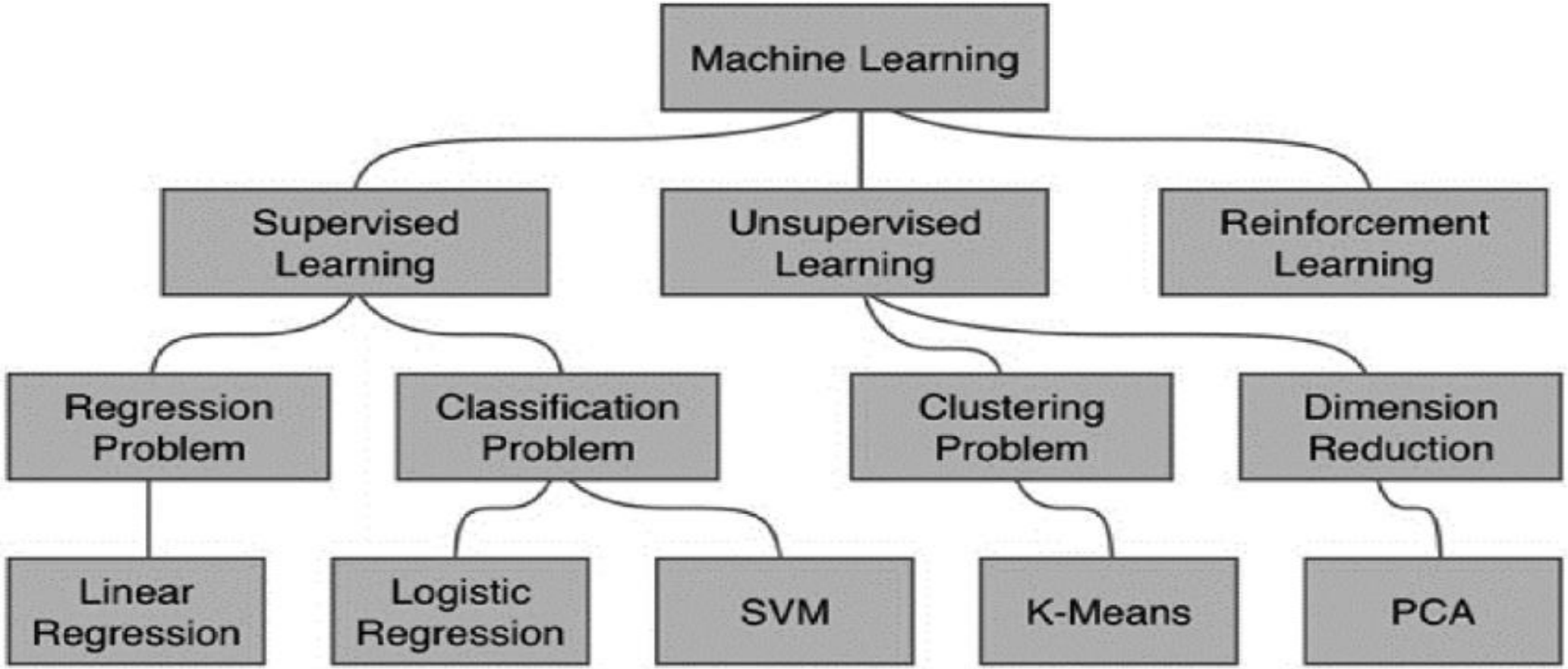
Lecture Title: [Machine Learning]

Artificial Intelligence

Artificial intelligence is a computer simulation of intelligent human behaviour. It is a computer or system that can perceive its surroundings, interpret its activities, and take action. Voice recognition, problem solving, learning, and planning are some examples .



Machine learning is an artificial intelligence technique that teaches computers to learn from experience. Machine learning algorithms employ computational methods to "learn" information directly from data rather than using a preconceived equation as a model. As the number of samples available for learning increases, the algorithms' performance improves adaptively.



Supervised Learning

Supervised learning is a type of machine learning where the model is trained on labeled data, meaning each input has a corresponding correct output. The algorithm learns by mapping inputs to outputs using known examples.

Types of Supervised Learning

1.Classification

1. Predicts discrete categories (e.g disease diagnosis).
2. Examples: Decision Trees, Random Forest, Support Vector Machines (SVM), Neural Networks.

2.Regression

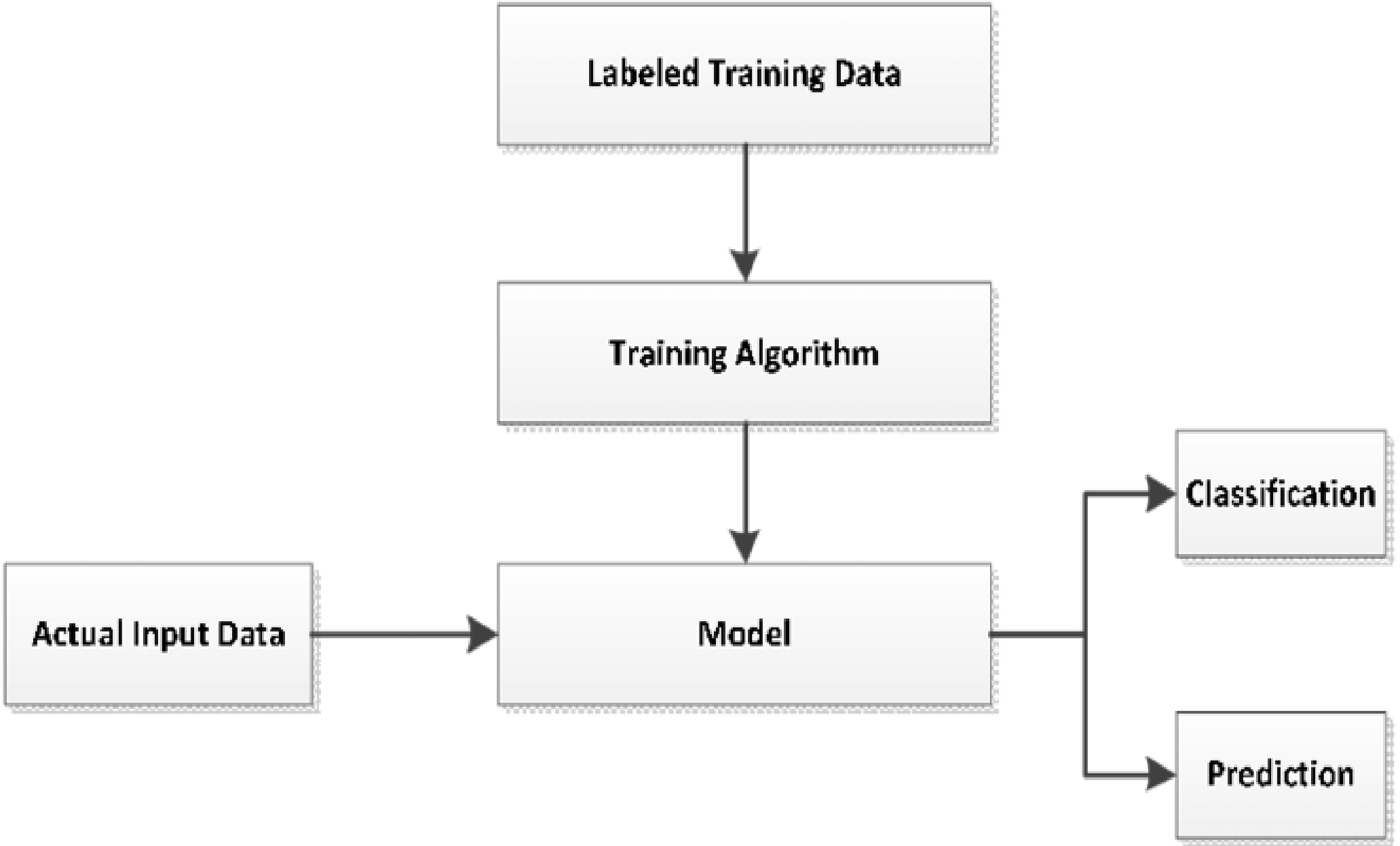
1. Predicts continuous values (e.g., house prices, stock prices).
2. Examples: Linear Regression, Polynomial Regression, Support Vector Regression (SVR).

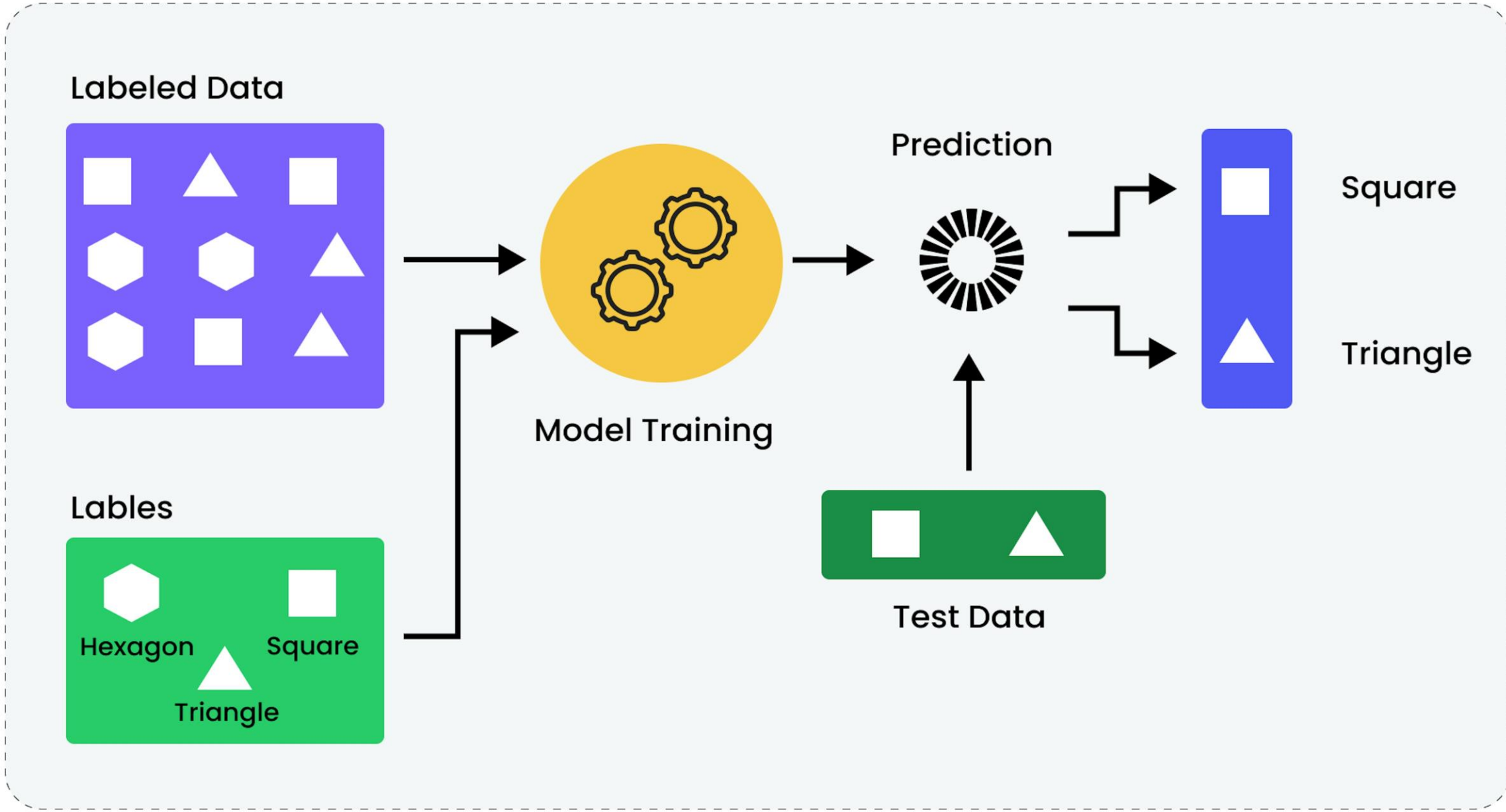
How Supervised Learning Works

1.Training Phase – The model learns from a labeled dataset (input-output pairs).

2.Testing Phase – The trained model is tested on new data to check its accuracy.

3.Prediction – The model makes predictions on unseen data based on learned patterns.


Labeled Training Data
Training Algorithm
Actual Input Data
Model
Classification
Prediction

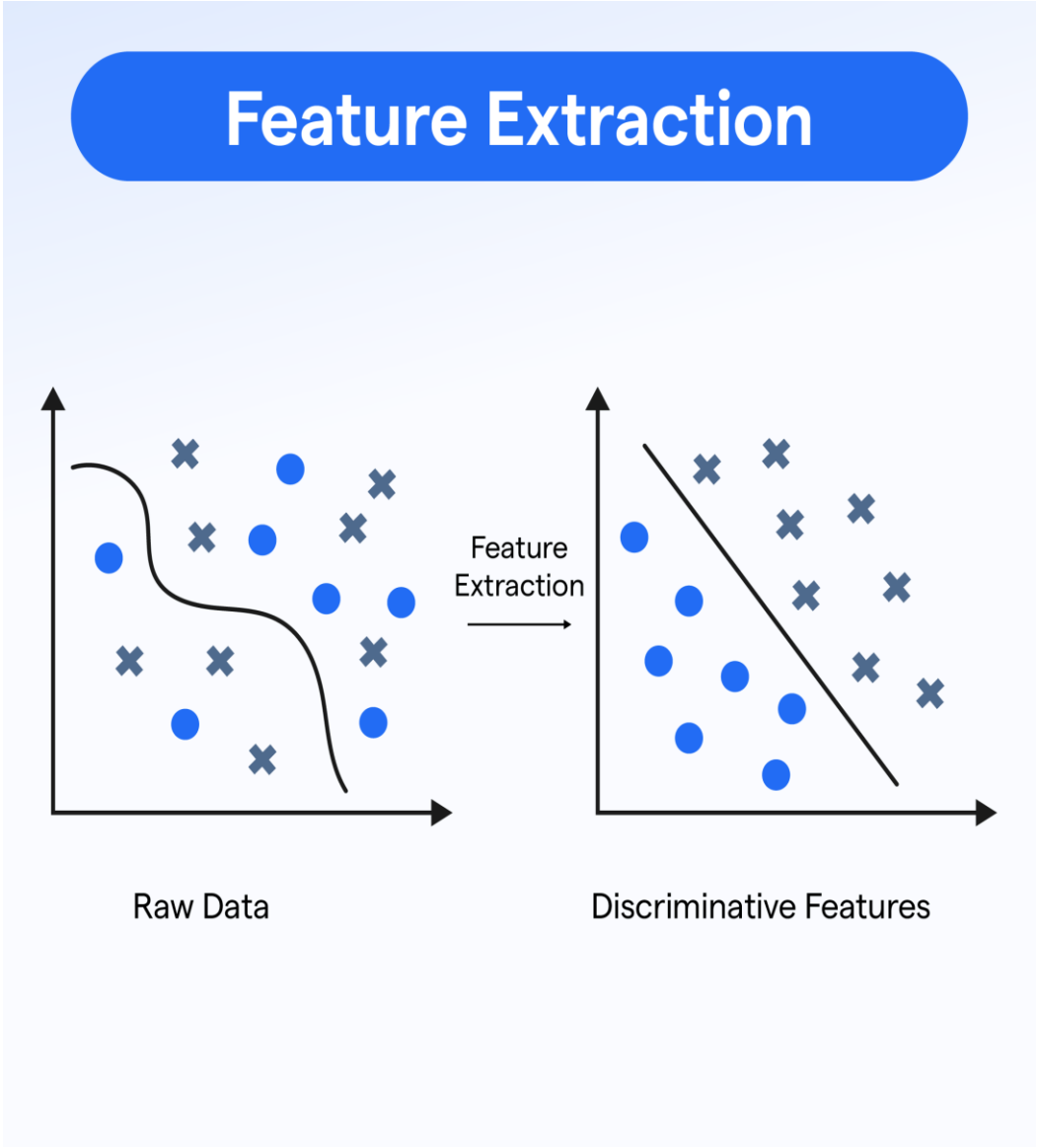

Labeled Data
Lables
Hexagon
Square
Triangle
Model Training
Prediction
Square
Triangle
Test Data

Feature Extraction in Machine Learning

Feature extraction is the process of selecting and transforming raw data into meaningful features that improve the performance of machine learning models. It helps reduce dimensionality, improve model accuracy, and speed up computations.

Why Feature Extraction?

- **Reduces complexity**: Eliminates irrelevant data, making models more efficient.
- **Improves accuracy**: Extracts the most informative features.
- **Enhances interpretability**: Helps understand what drives model predictions.
- **Prevents overfitting**: Reduces noise and unnecessary information.



Unsupervised Learning

Unsupervised learning is a type of machine learning where the model is trained on **unlabeled data**—meaning the algorithm explores patterns, structures, or relationships without predefined outputs.

Types of Unsupervised Learning

1.Clustering

Groups similar data points together based on patterns.

Examples:

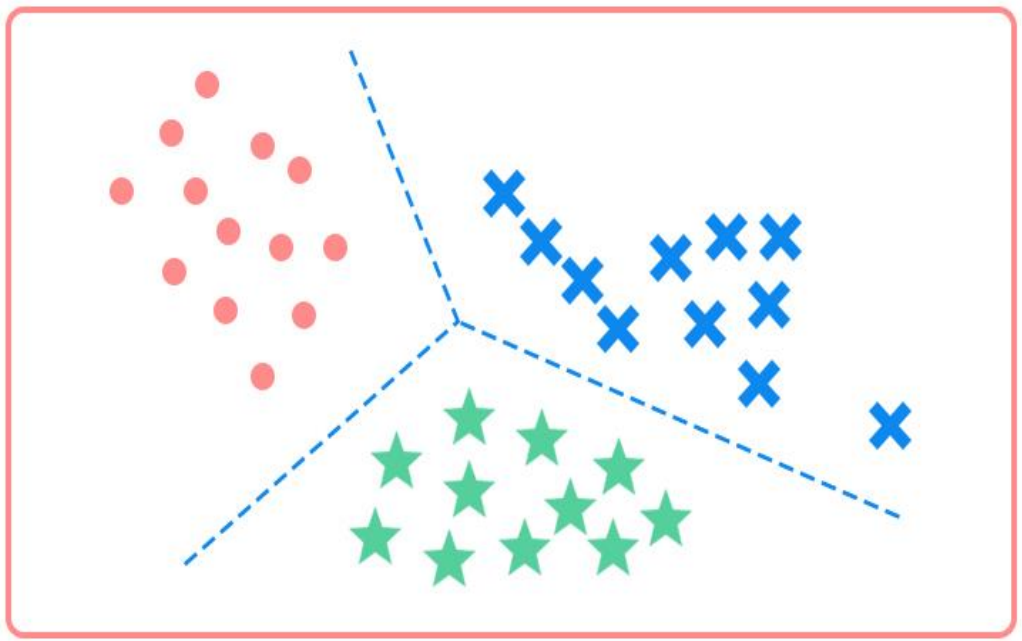
1.K-Means Clustering
2.Hierarchical Clustering

Applications:

1.Image segmentation

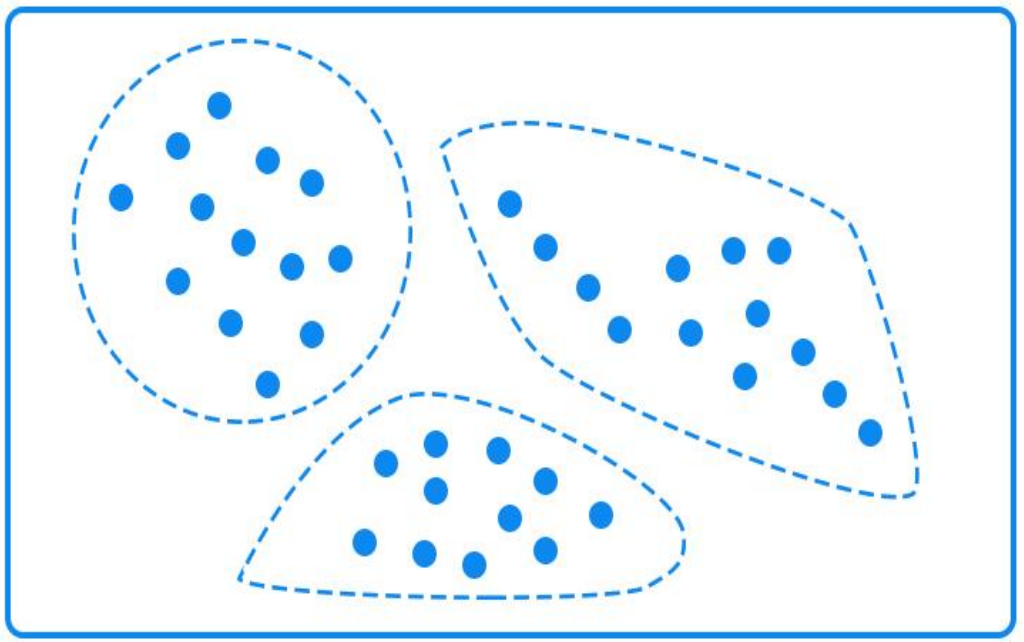
Supervised vs. Unsupervised Learning

Classification



Supervised learning

Clustering

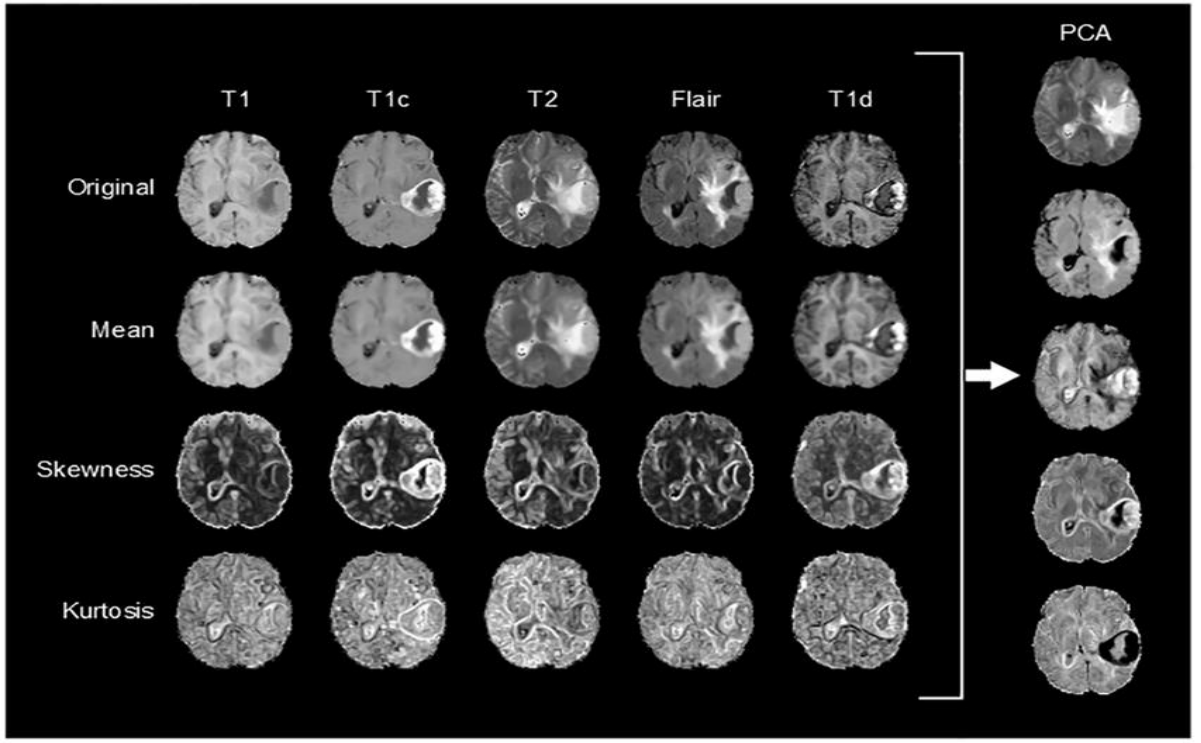


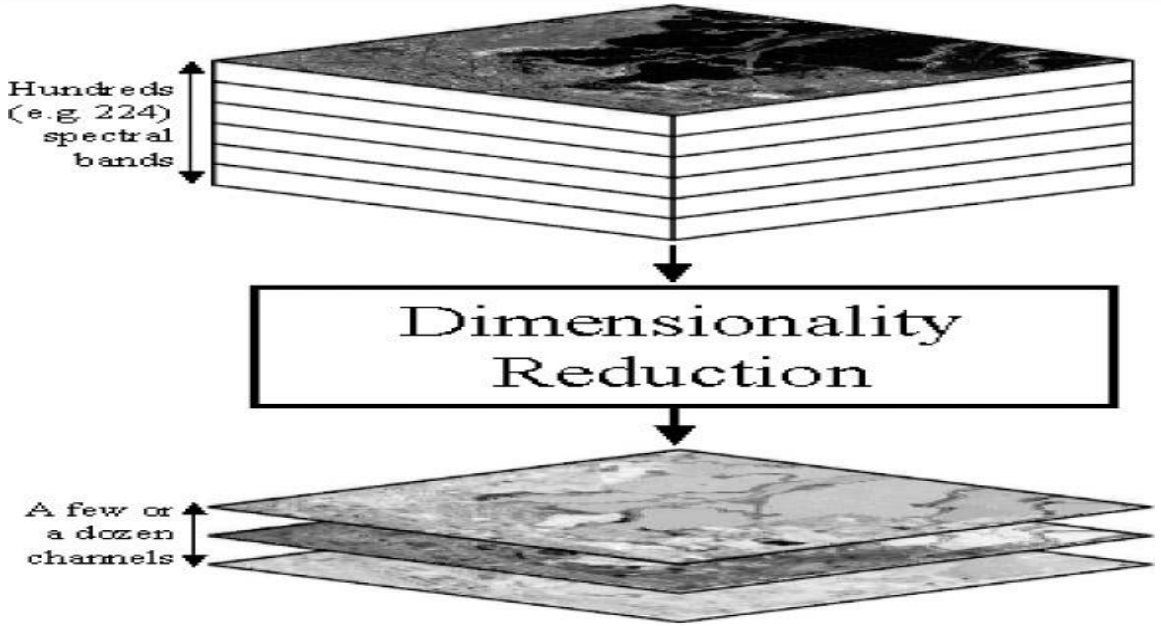
Unsupervised learning

2.Dimensionality Reduction

is a technique used in machine learning to reduce the number of input variables (features) while preserving important information. This helps improve computational efficiency, reduce noise, and prevent overfitting.

- **Examples:**
  - Principal Component Analysis (PCA)
  - t-Distributed Stochastic Neighbor Embedding (t-SNE)
  - Autoencoders
- **Applications:**
  - Feature selection in machine learning models
  - Image compression
  - Data visualization



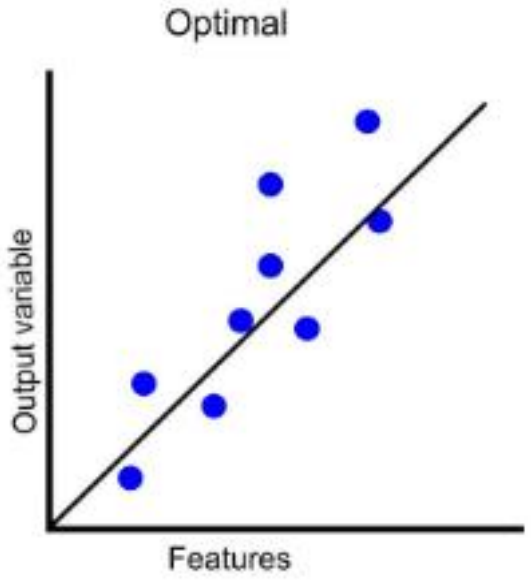


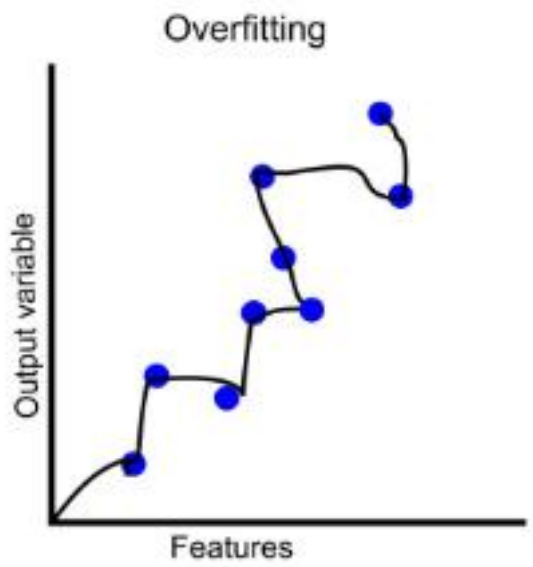
Overfitting

occurs when a model learns the **training data too well**, including its noise and minor fluctuations. As a result, the model **performs exceptionally well on training data but poorly on unseen (test) data** because it fails to generalize.

Signs of Overfitting

- Very high accuracy on training data but poor accuracy on test data.
- The model captures even small random variations in the training data.
- Poor performance on new, unseen data.

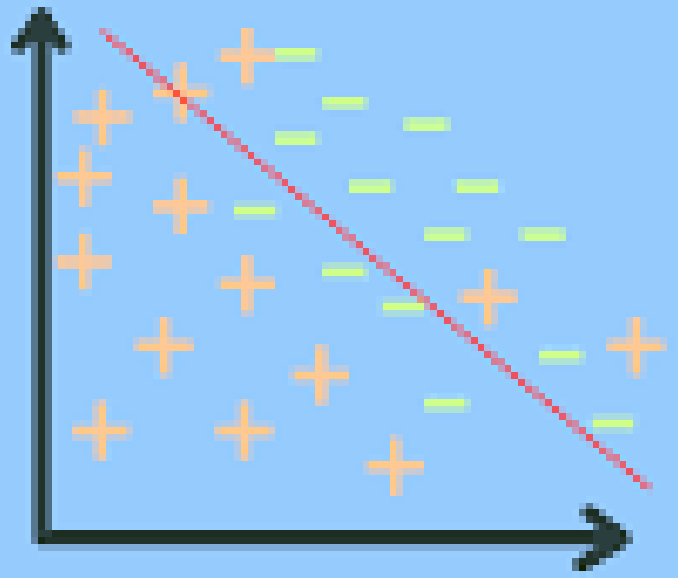




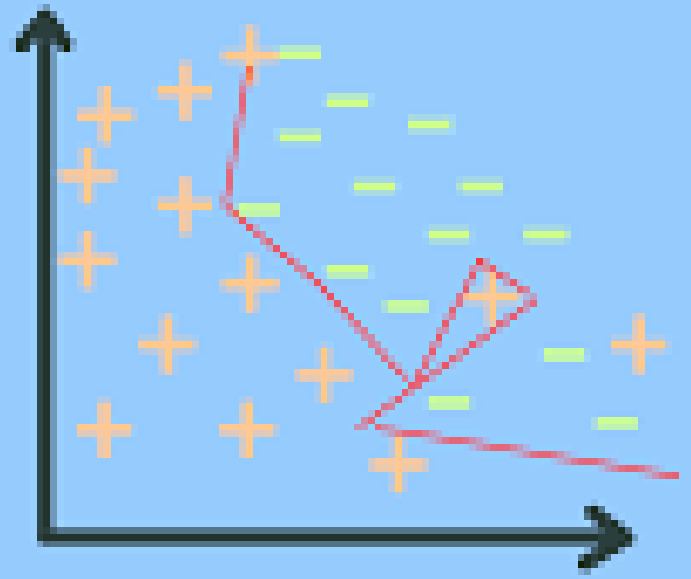
Underfitting

Underfitting happens when a model is **too simple** to capture the underlying patterns in the data. It **fails to perform well on both training and test data**, leading to **poor accuracy** overall.

- **Signs of Underfitting**
- ◆ Low accuracy on both training and test datasets.
  ◆ The model does not capture important trends in the data.
  ◆ High bias (i.e., the model makes overly simplistic assumptions).



Underfitting



Overfitting