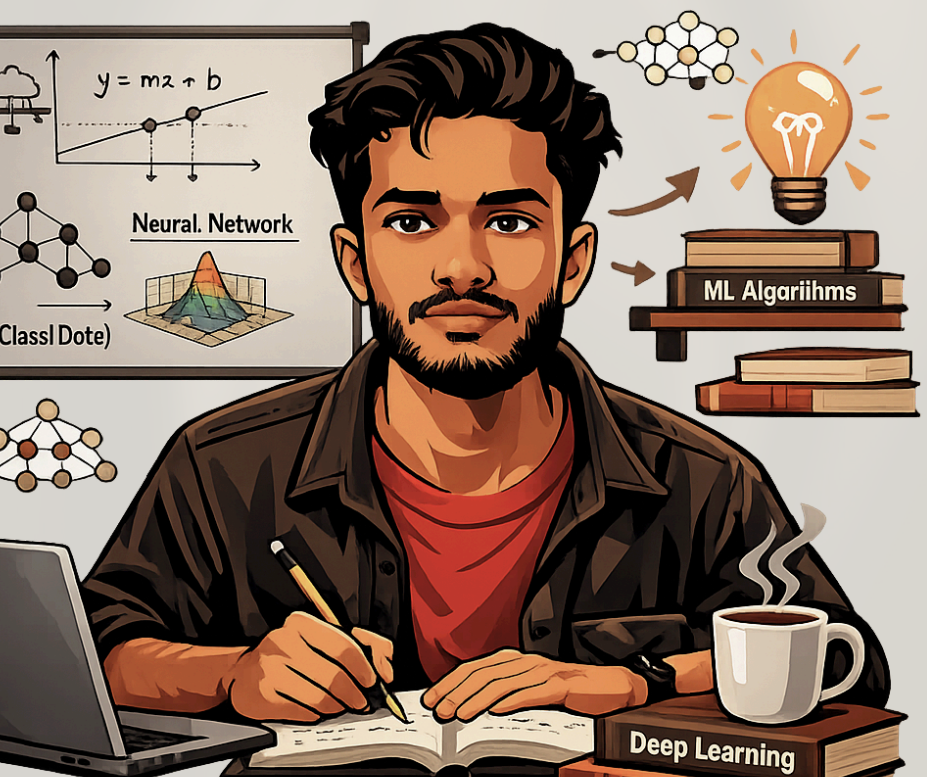
THE Guy QUERY

9 Machine Learning Algorithms

YOU MUST KNOW!



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1. LINEAR REGRESSION

What problem it solves (in very simple words)

You have numbers and you want to predict another number.

Example:

- House size → House price
- Years of experience → Salary

Core idea

Draw the best straight line that fits the data.

Formula

$$y=mx+by = mx + by=mx+b$$

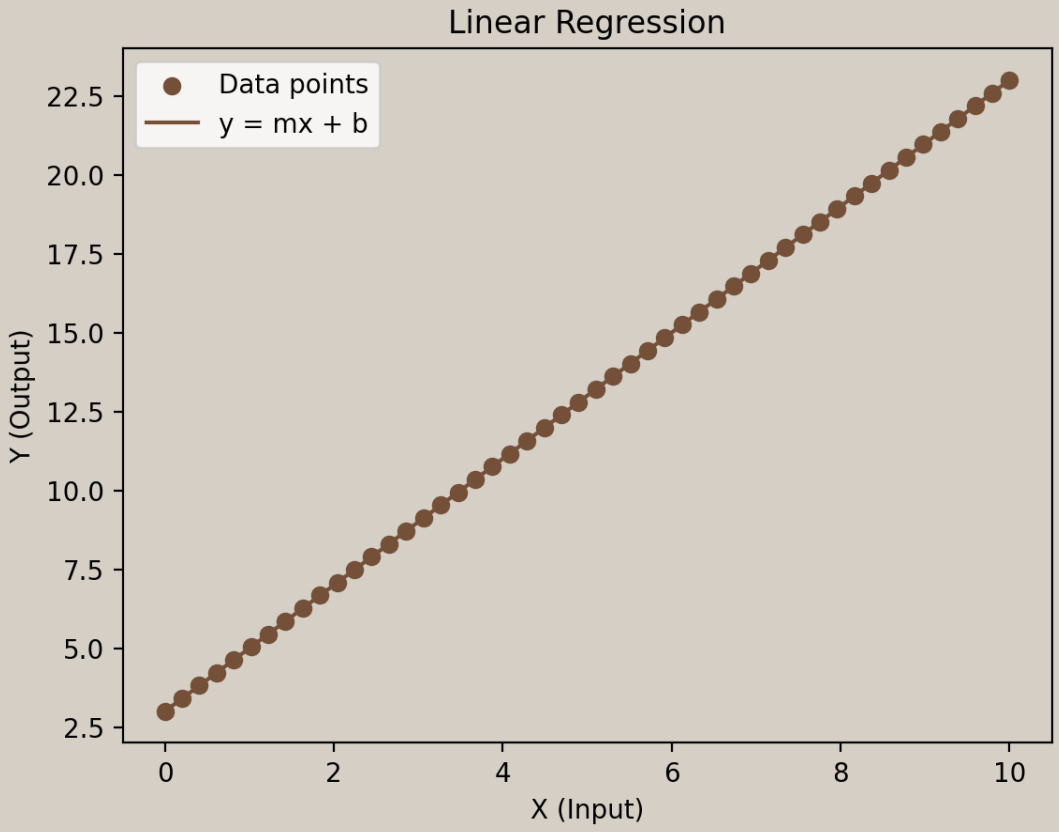
Where:

- x = input (feature)
- y = output (prediction)
- m = slope (how fast y increases when x increases)
- b = intercept (value of y when x = 0)

How the model learns

It minimises error using Mean Squared Error (MSE):

$$MSE=n1\,\Sigma\,(y\ actual-y\ predicted)2$$



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2. LOGISTIC REGRESSION

What problem it solves (in very simple words)

- YES / NO,
- 0 / 1,
- TRUE / FALSE

Example:

- Spam or Not Spam
- Fraud or Not Fraud

Core idea

Convert a number into a probability between 0 and 1

Step 1: Linear equation

$$z = w \cdot x + b$$

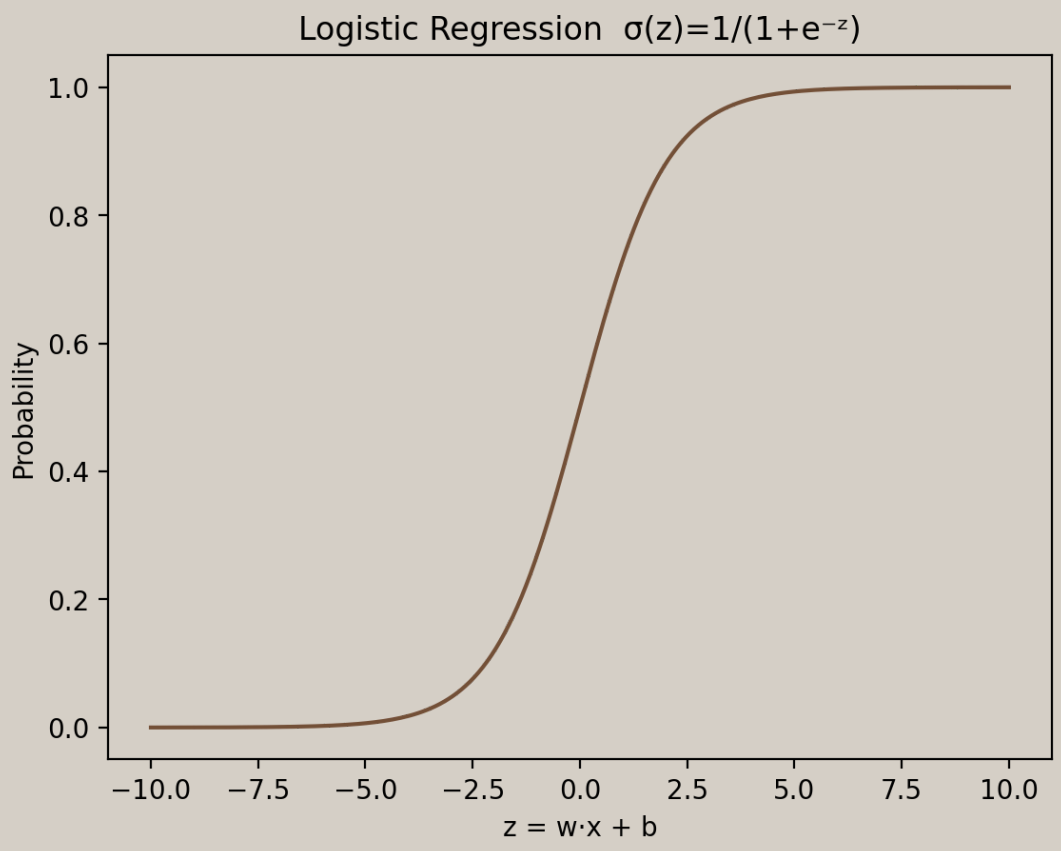
Step 2: Sigmoid function

$$\sigma(x) = \frac{1}{1+e^{-x}} = \frac{e^{x}}{1+e^{x}} = 1 - \sigma(-x).$$

This squeezes output between 0 and 1.

Decision rule

- If probability ≥ 0.5 → Class 1
- Else → Class 0¡¡



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3. DECISION TREE

What problem it solves (in very simple words)

Decision making using IF–ELSE logic

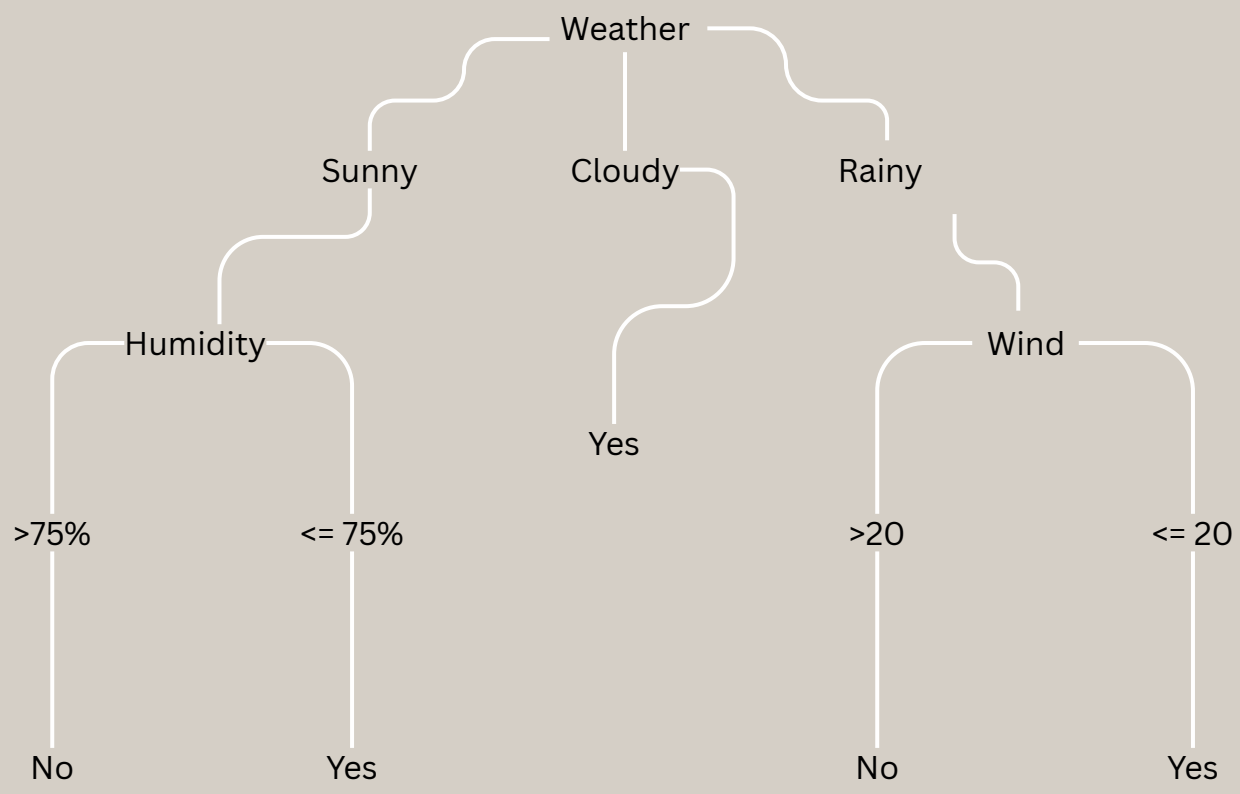
Example:

IF **age** > 25
  IF **income** > 50k → Buy
  ELSE → Not Buy
ELSE → Not Buy

How it splits data

- Uses metrics:
- Gini Impurity
- Entropy

$$Entropy = -\sum p \log p$$



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4. RANDOM FOREST

What problem it solves (in very simple words)

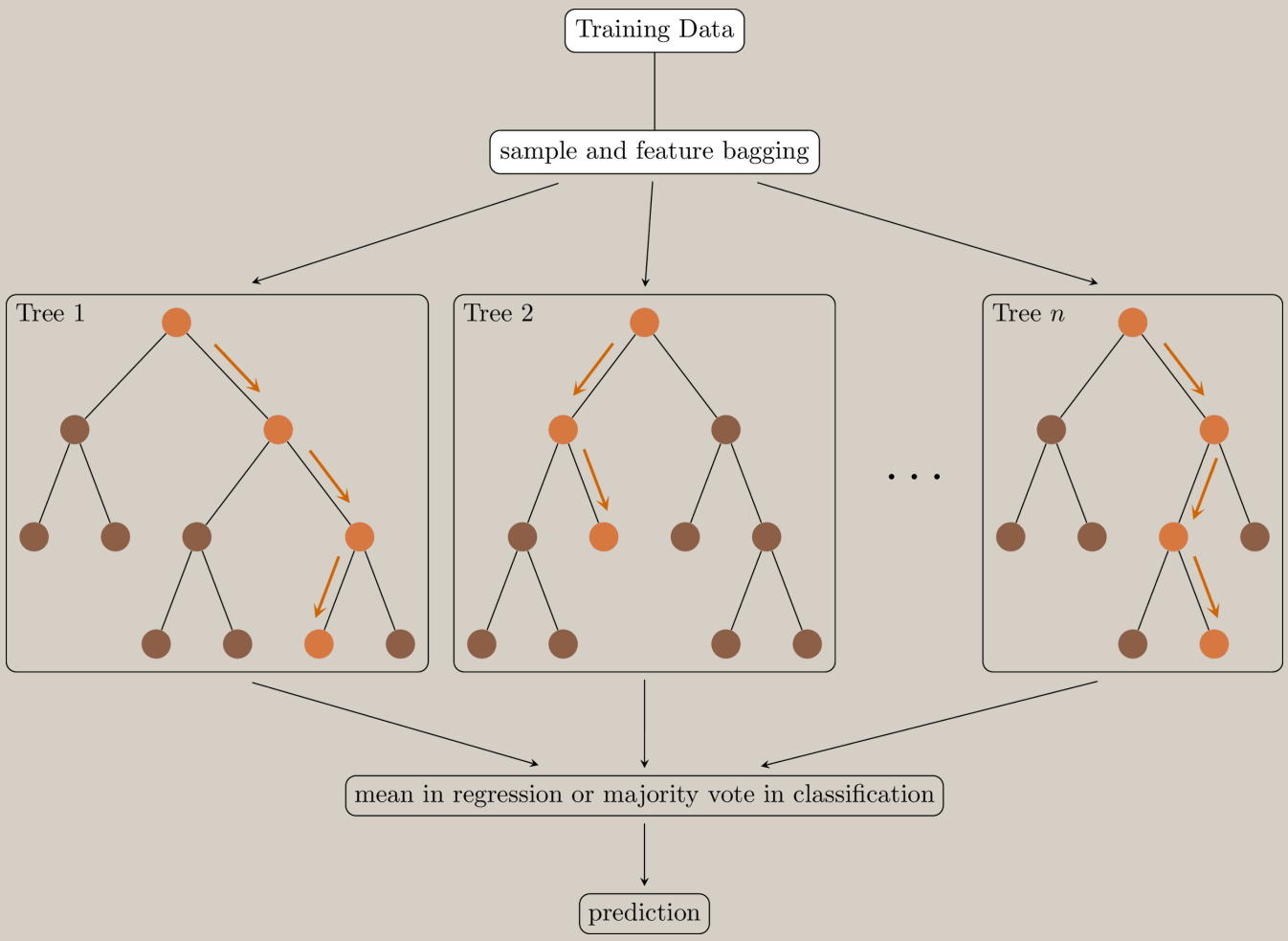
Why Decision Trees fail alone?
They overfit (memorize data).

Solution

Build many trees and combine their answers.

How prediction works?

- Classification → Majority vote
- Regression → Average



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5. SUPPORT VECTOR MACHINE (SVM)

What problem it solves (in very simple words)

Core idea

Find the best separating line with maximum margin.

Mathematical goal

Maximize:

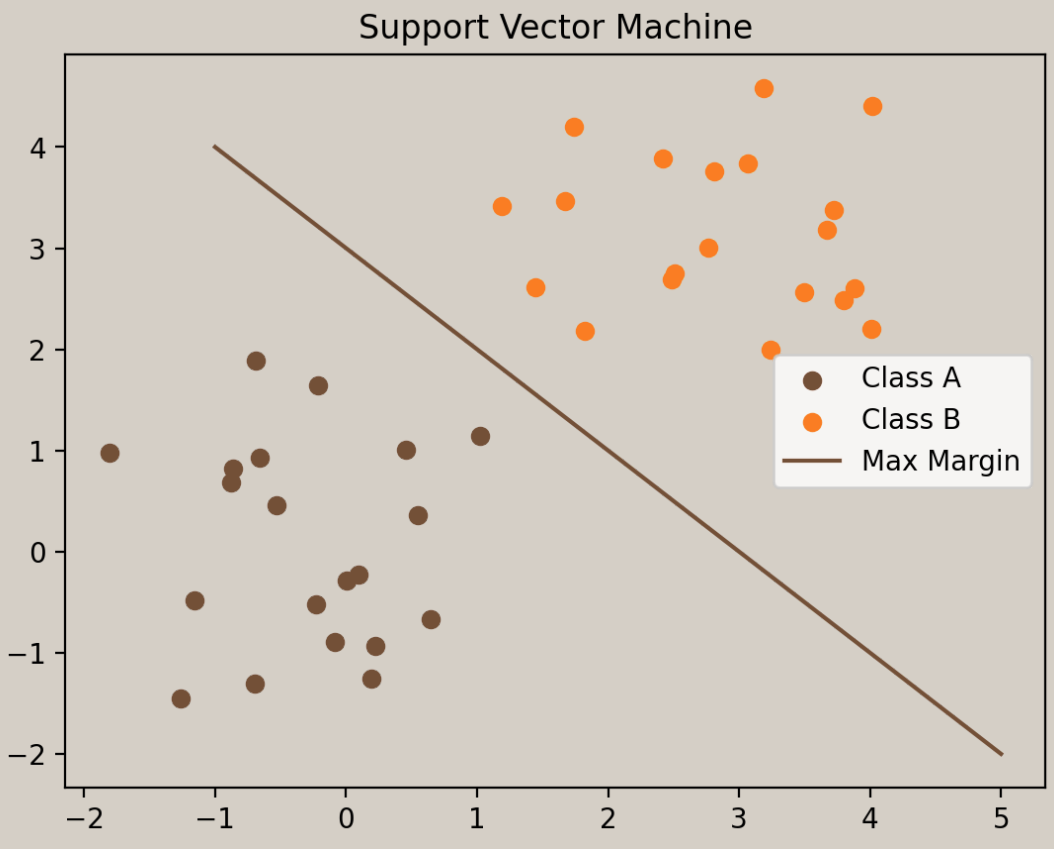
$$\frac{2}{\| W \|}$$ (where **w** is the weight vector)

Subject to:

$$y_i(w \cdot x_i + b) \geq 1$$

Why SVM is powerful ?

- Works in high dimensions
- Uses kernel trick for non-linear data



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6. K-NEAREST NEIGHBORS (KNN)

What problem it solves (in very simple words)

Core idea

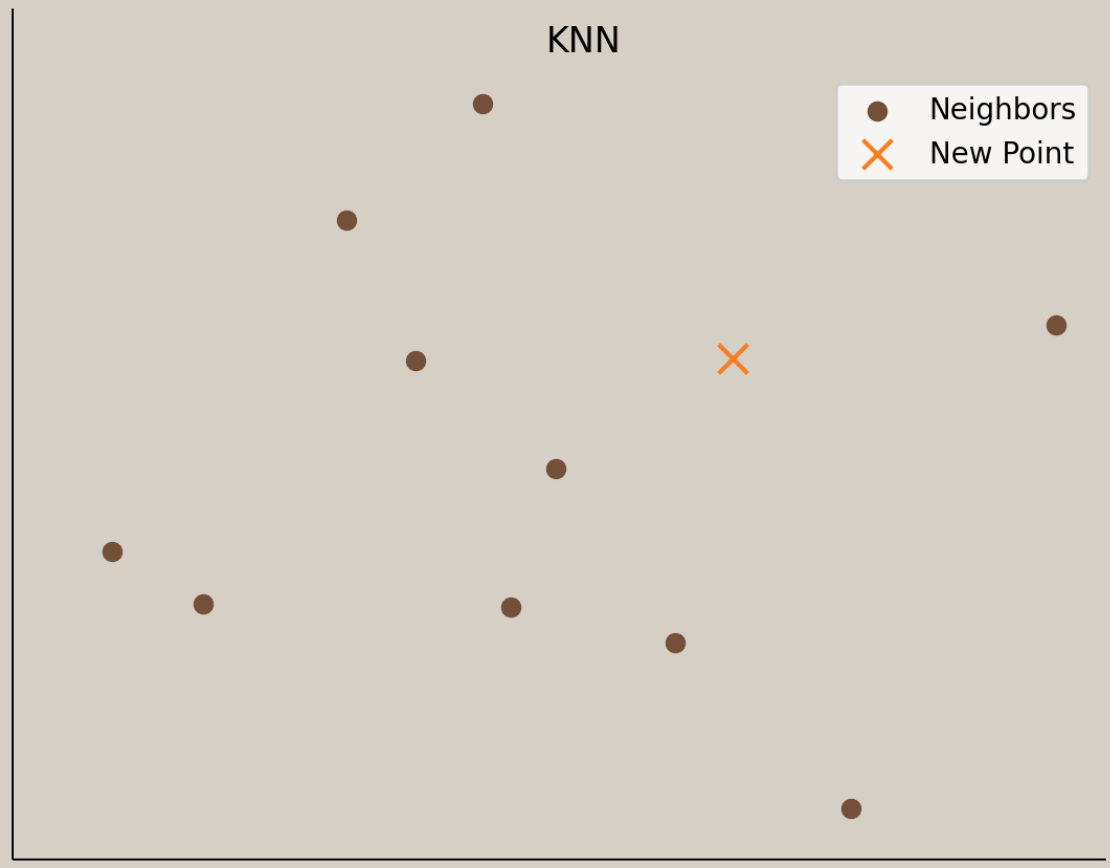
"You are what your neighbors are."

How it works

1. Choose K
2. Measure distance
3. Majority class wins

Distance formula (Euclidean)

$$d=\sqrt{(x1-x2)2+(y1-y2)2}$$



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7. NAIVE BAYES

What problem it solves (in very simple words)

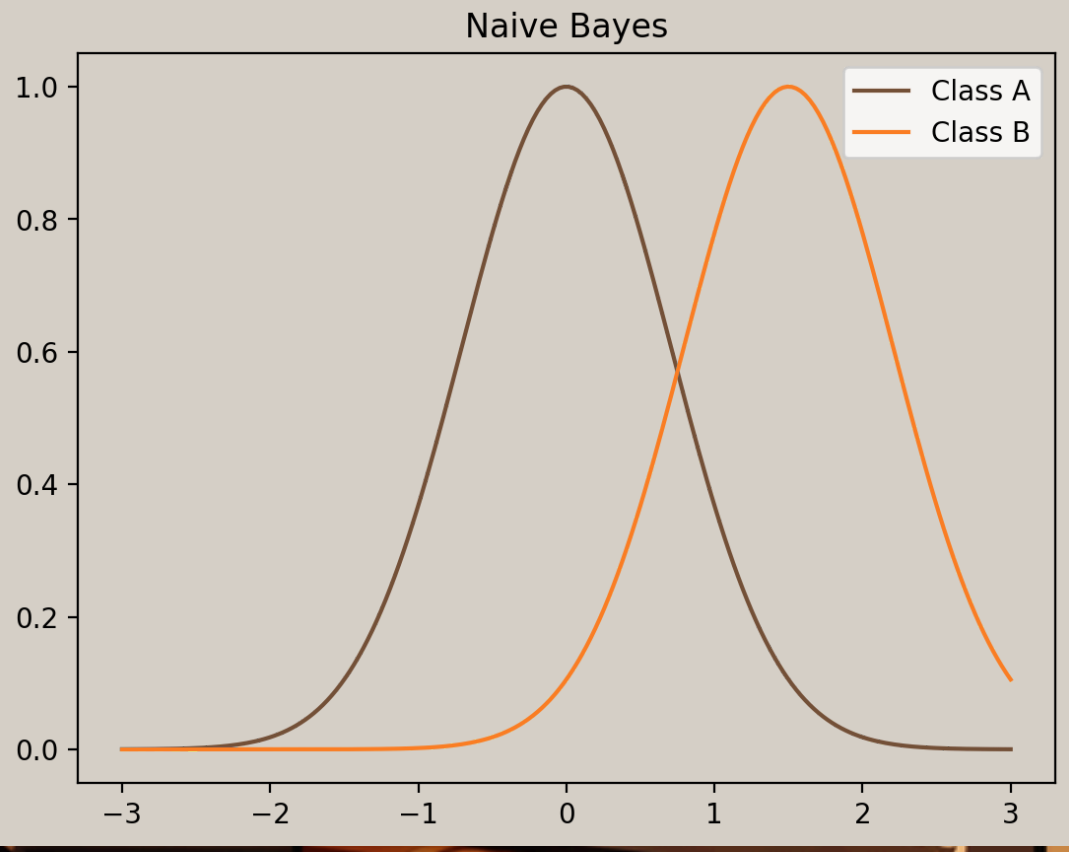
Core idea

Uses probability to decide.

Bayes Theorem

$$P(\text{Class} \mid \text{Data}) = \frac{P(\text{Data} \mid \text{Class}) \cdot P(\text{Class})}{P(\text{Data})}$$

Why "**Naive**" ?
Assumes features are independent (even if they aren't).



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8. K-MEANS CLUSTERING

What problem it solves (in very simple words)

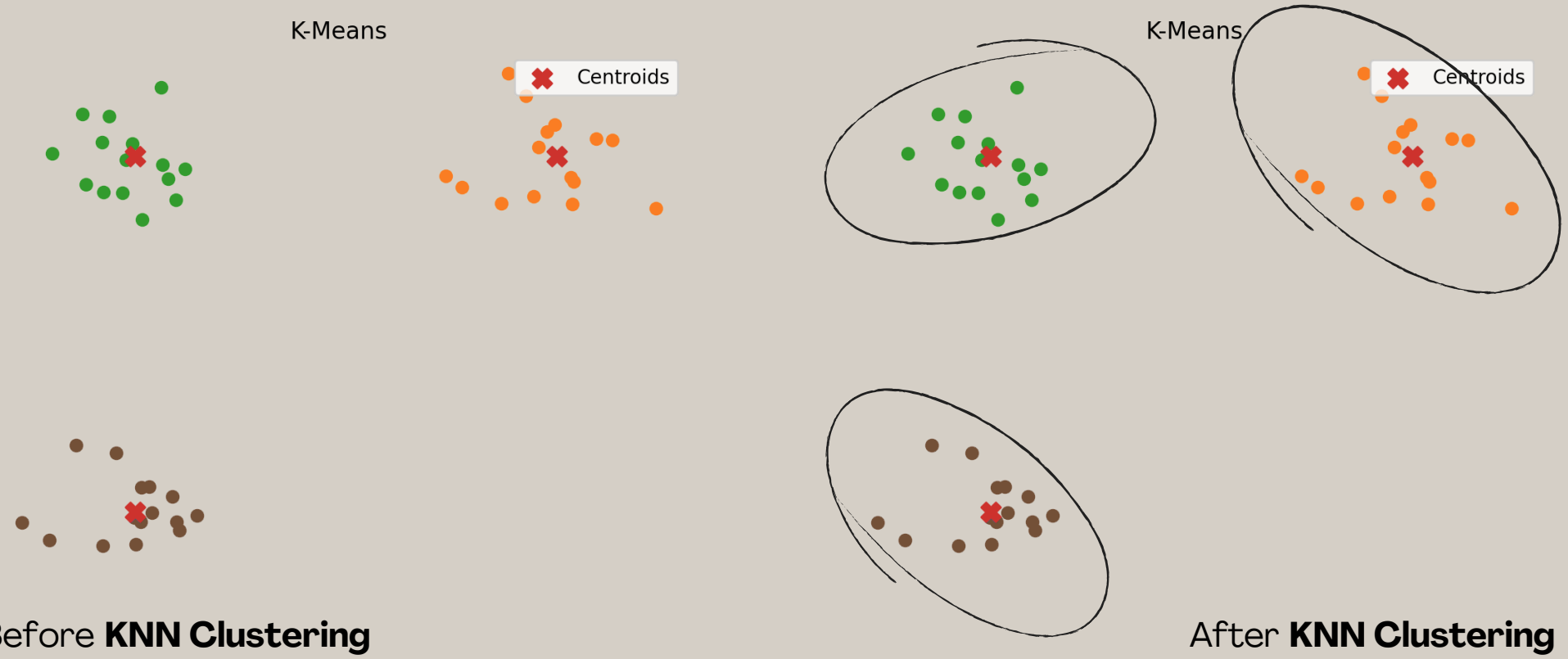
What problem it solves
Grouping **unlabelled data.**

Algorithm steps

1. Choose K
2. Assign points to nearest centroid
3. Update centroid
4. Repeat until convergence

Objective function

$$\Sigma \; | \; | \; xi - \mu k \; | \; | \; 2$$



Before **KNN Clustering**

After **KNN Clustering**

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8. K-MEANS CLUSTERING

What problem it solves (in very simple words)

Core idea

Stacked linear + non-linear transformations

Single neuron formula

$$y = f(w \cdot x + b)$$

Where:

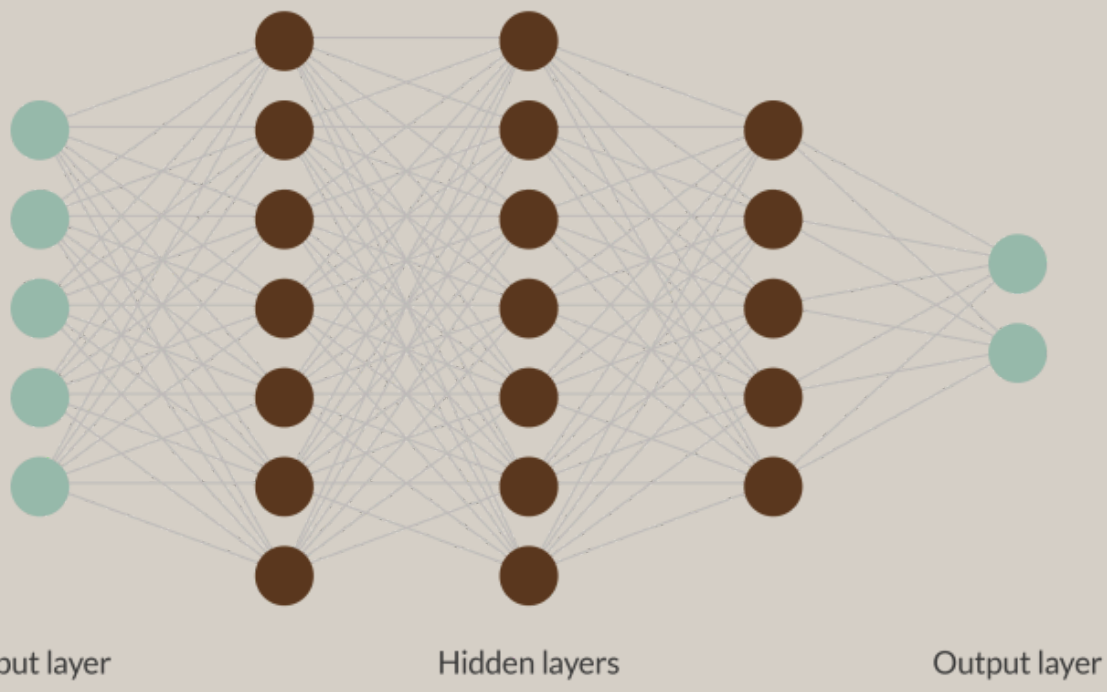
f = activation (ReLU, Sigmoid, etc.)

Training

Uses:

- Loss function
- Backpropagation
- Gradient Descent

$$w_{new} = w_{old} - \alpha \frac{\partial L}{\partial w}$$



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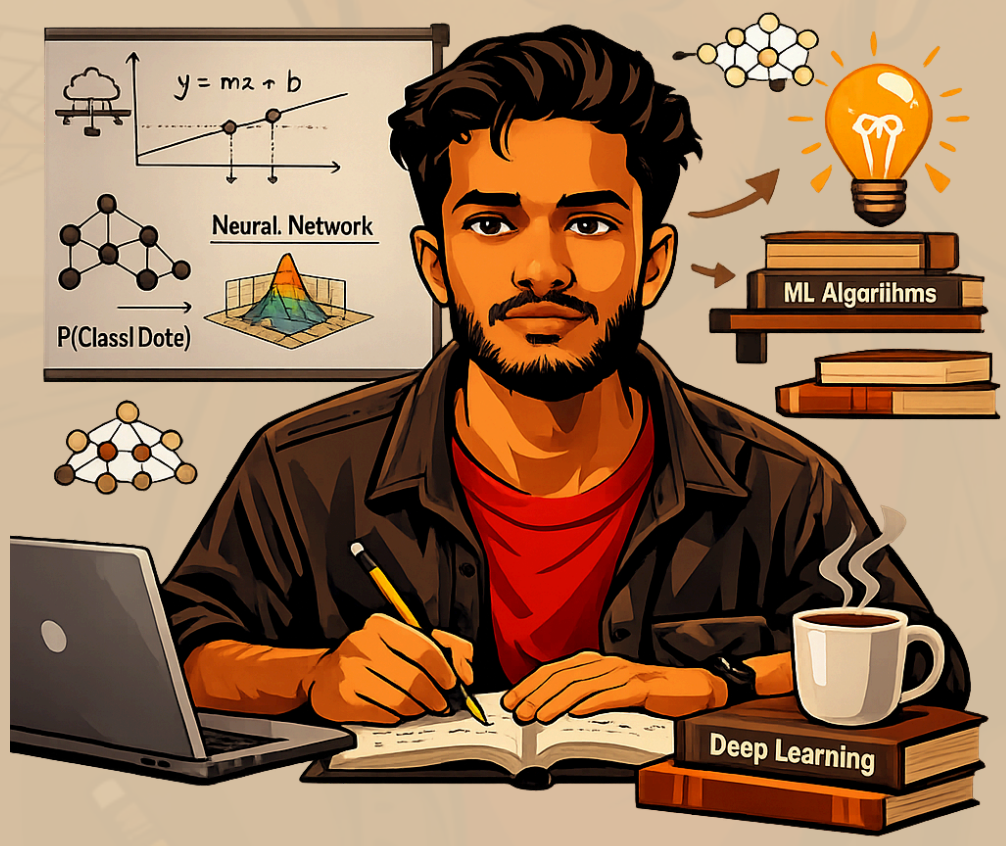

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