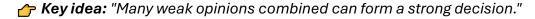
Voting Ensemble – Introduction & Core Idea

1. What is Voting Ensemble?

- Voting Ensemble is the simplest type of Ensemble Learning.
- It combines predictions from different models (called base learners) to make a final decision.
- Think of it like a **democratic election**: each model votes, and the majority decides the outcome.



2. Why do we need it?

- A single model may not always perform well.
- Different models capture different patterns in data.
- By combining them, we reduce the chance of individual model mistakes.
- Final prediction becomes more stable and accurate.

3. Types of Voting

Two main kinds:

Hard Voting

- Each model predicts a class label.
- Final prediction = majority vote.
 - **❖** Example: If 3 models predict [Dog, Dog, Cat], → final = **Dog**.
- Works well when models are strong and diverse.

Soft Voting

- Each model predicts probability scores (confidence).
- The probabilities are averaged, and the class with the highest average probability is chosen.
 - Example:
 - Model A → Dog 70%, Cat 30%
 - Model B → Dog 40%, Cat 60%
 - Model C → Dog 60%, Cat 40%
 - Average: Dog 56.6%, Cat 43.3% → final = Dog.
- Usually performs **better than Hard Voting** (because it uses confidence, not just the label).

4. Core Idea Behind Voting Ensemble

- "Two heads are better than one."
- If models are diverse and independent, their errors won't overlap much.
- Combining them reduces the overall error.
- Works best when:
 - 1. Base models are **different** (like Logistic Regression + SVM + Decision Tree).
 - 2. Each model performs better than random guessing.

5. Analogy to Understand

Imagine 5 doctors diagnosing a disease:

- One might miss a symptom, another might overestimate it.
- But when they all vote, the combined opinion is usually **more accurate** than any one doctor alone.

That's exactly how Voting Ensemble works.

✓ Key Takeaway:

Voting Ensemble is about combining **multiple diverse models** through majority (Hard) or probability averaging (Soft). It improves stability, reduces mistakes, and is often the **first step in Ensemble Learning**.