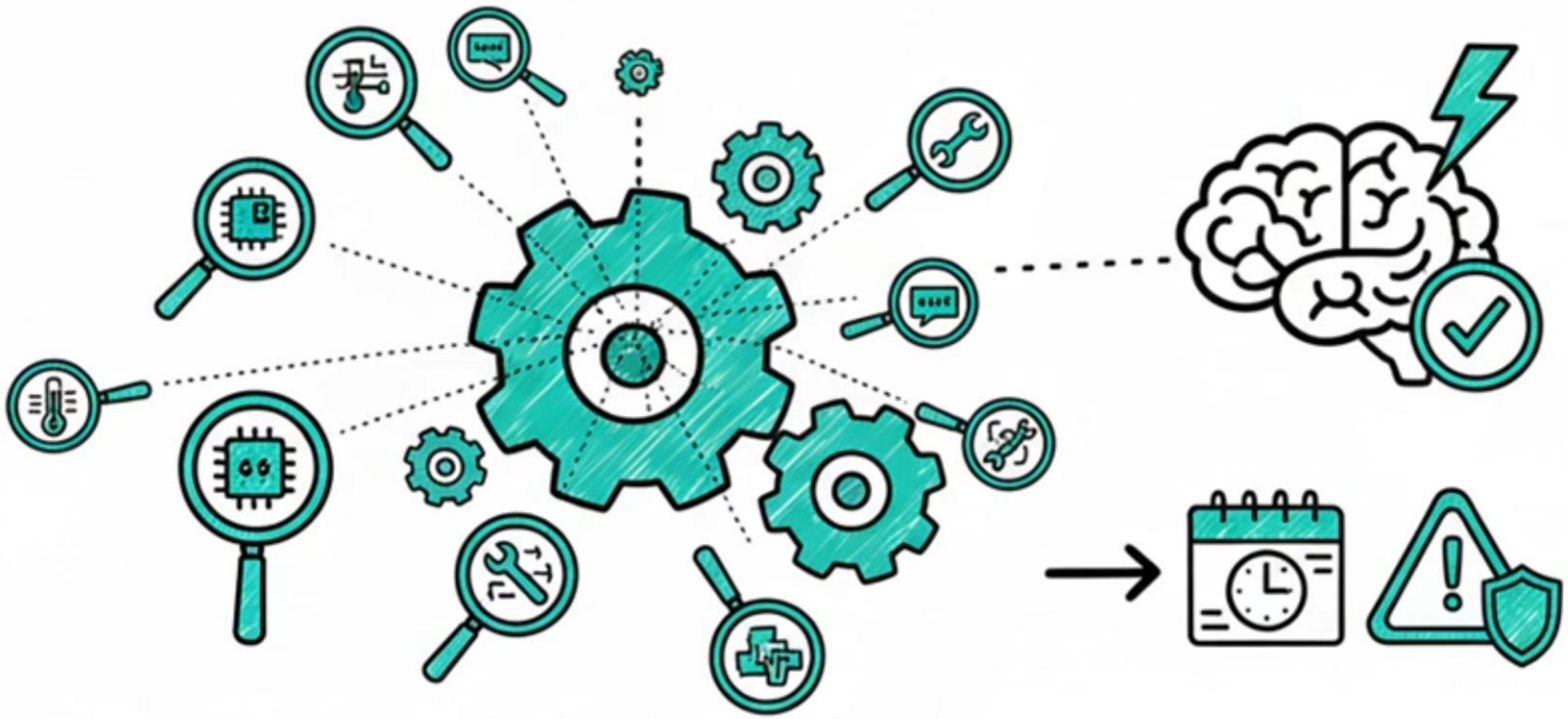
AI Ensemble for Predictive Maintenance



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A High-Stakes Prediction

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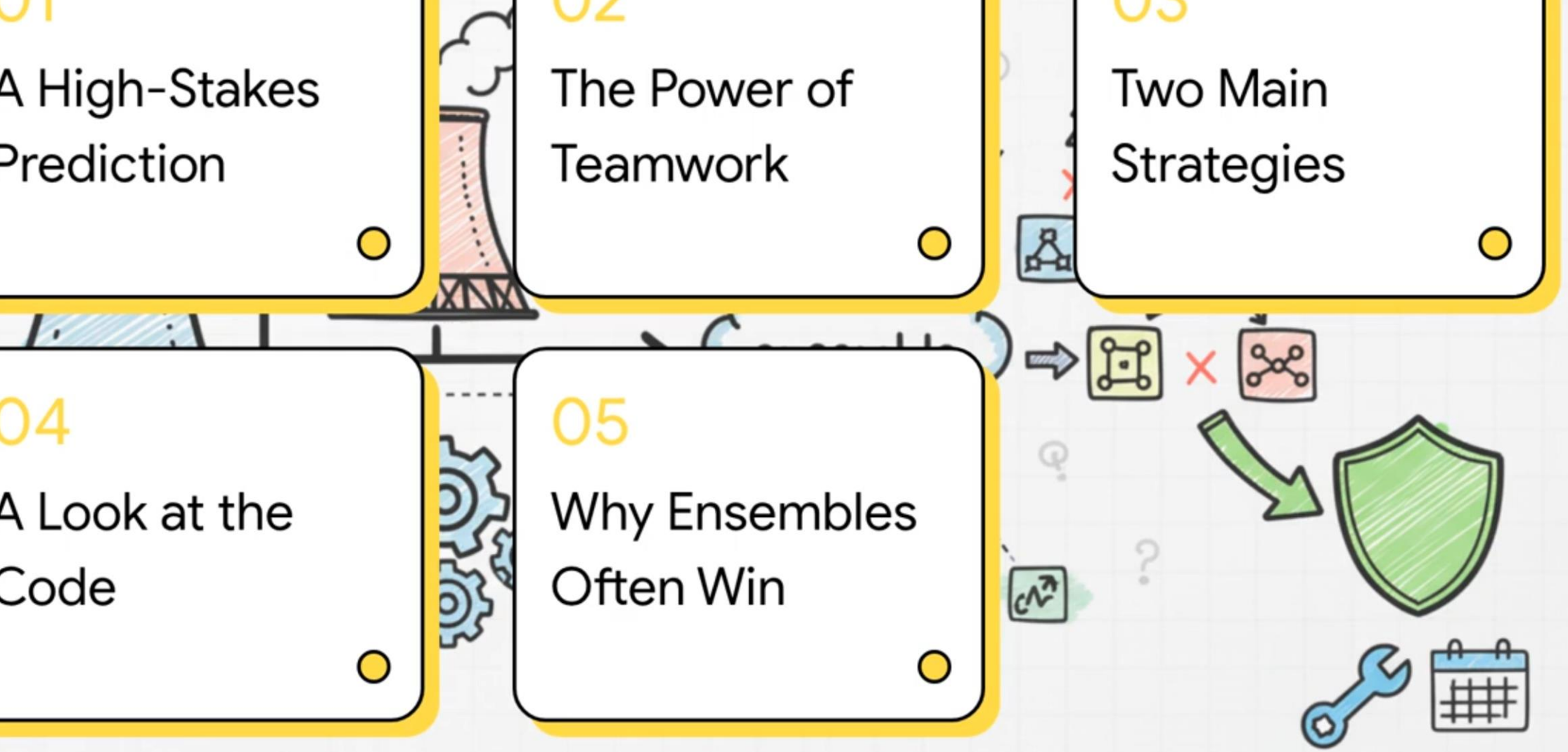
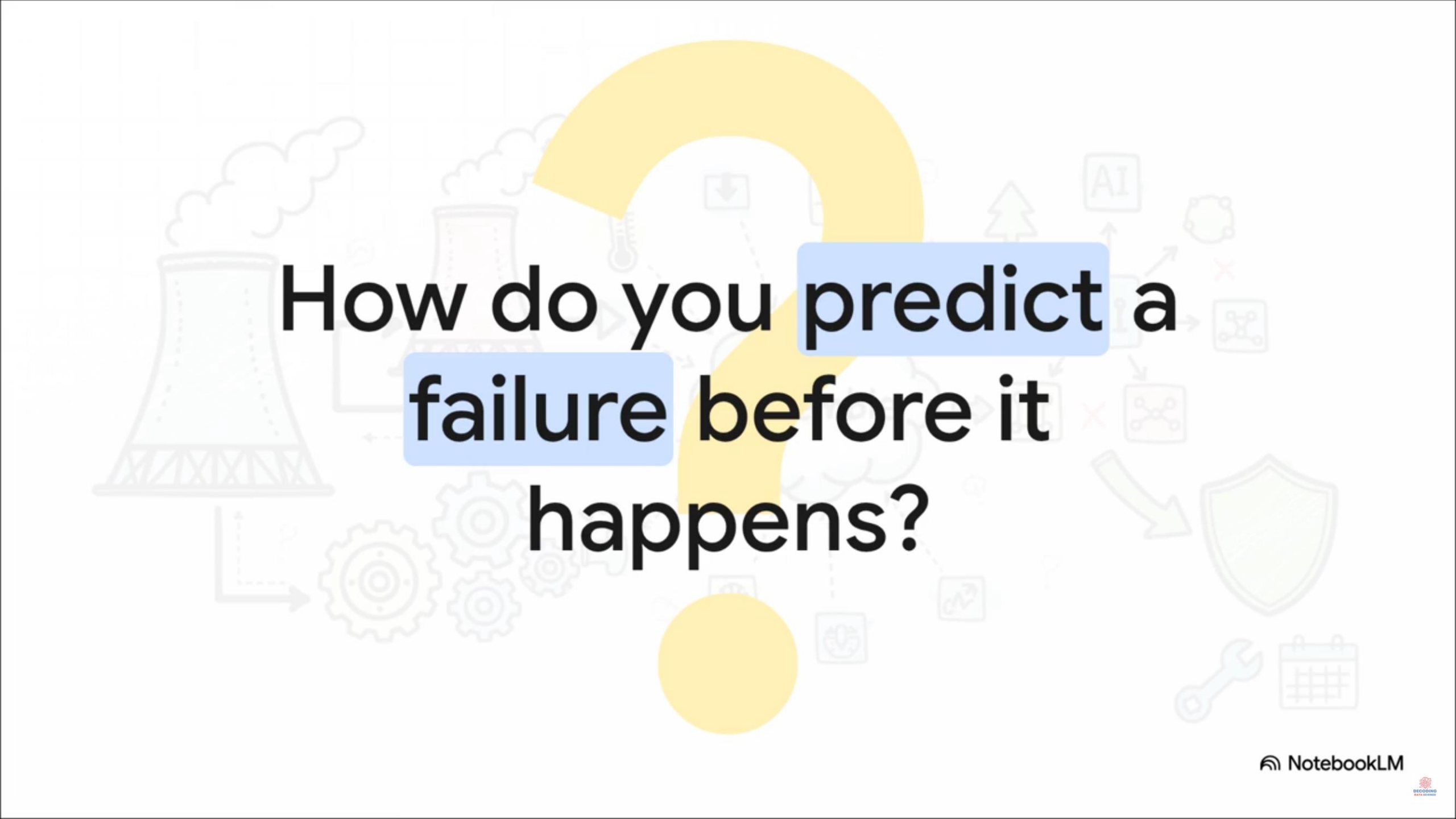
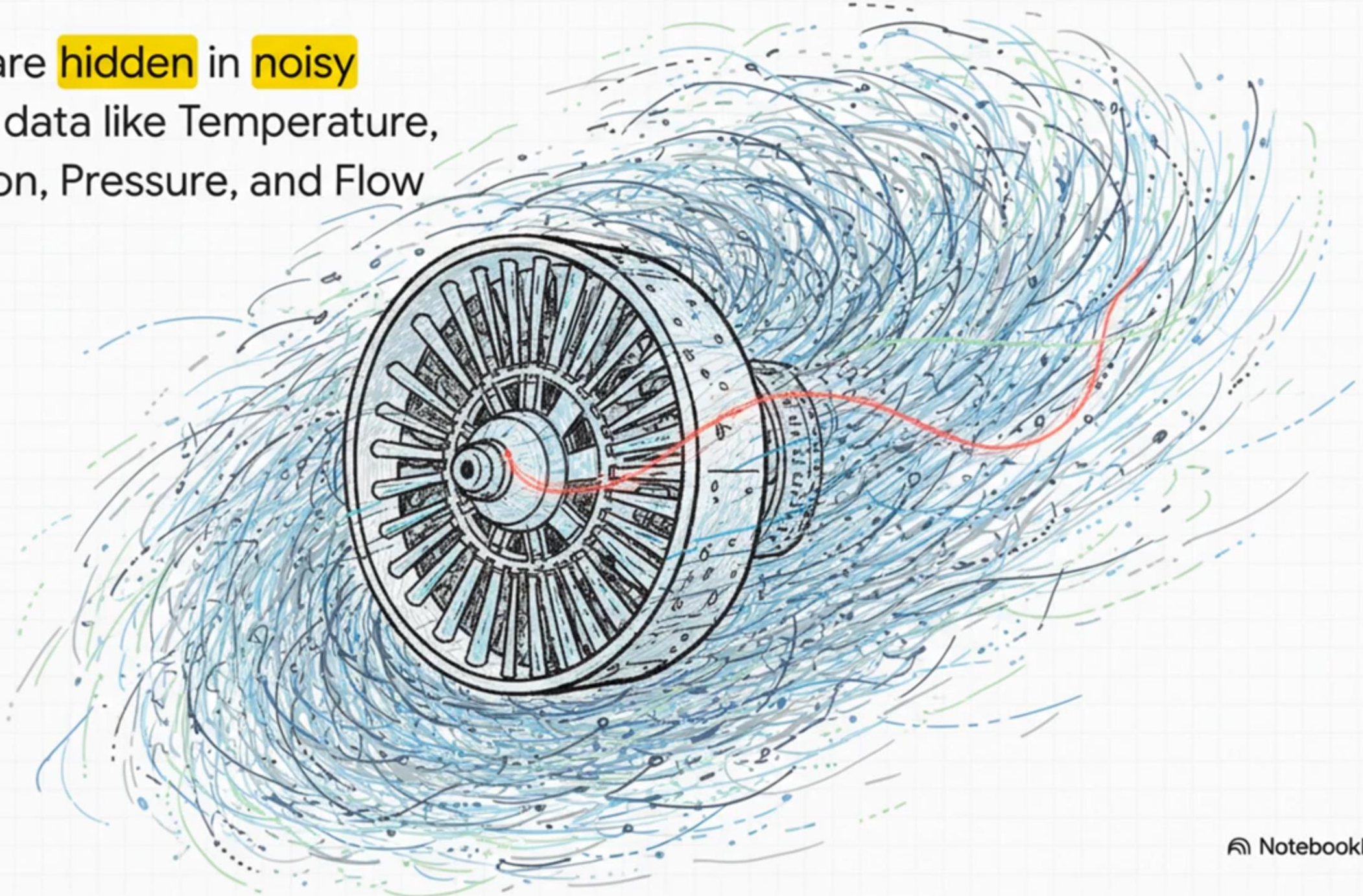
Why Ensembles Often Win





Clues are hidden in noisy sensor data like Temperature, Vibration, Pressure, and Flow Rate.



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The Power of Teamwork

Ensemble Methods

Ensemble Methods

Techniques that combine multiple 'weak' models to create one 'strong' predictive model.

The Power of the Team

BETTER GENERALIZATION

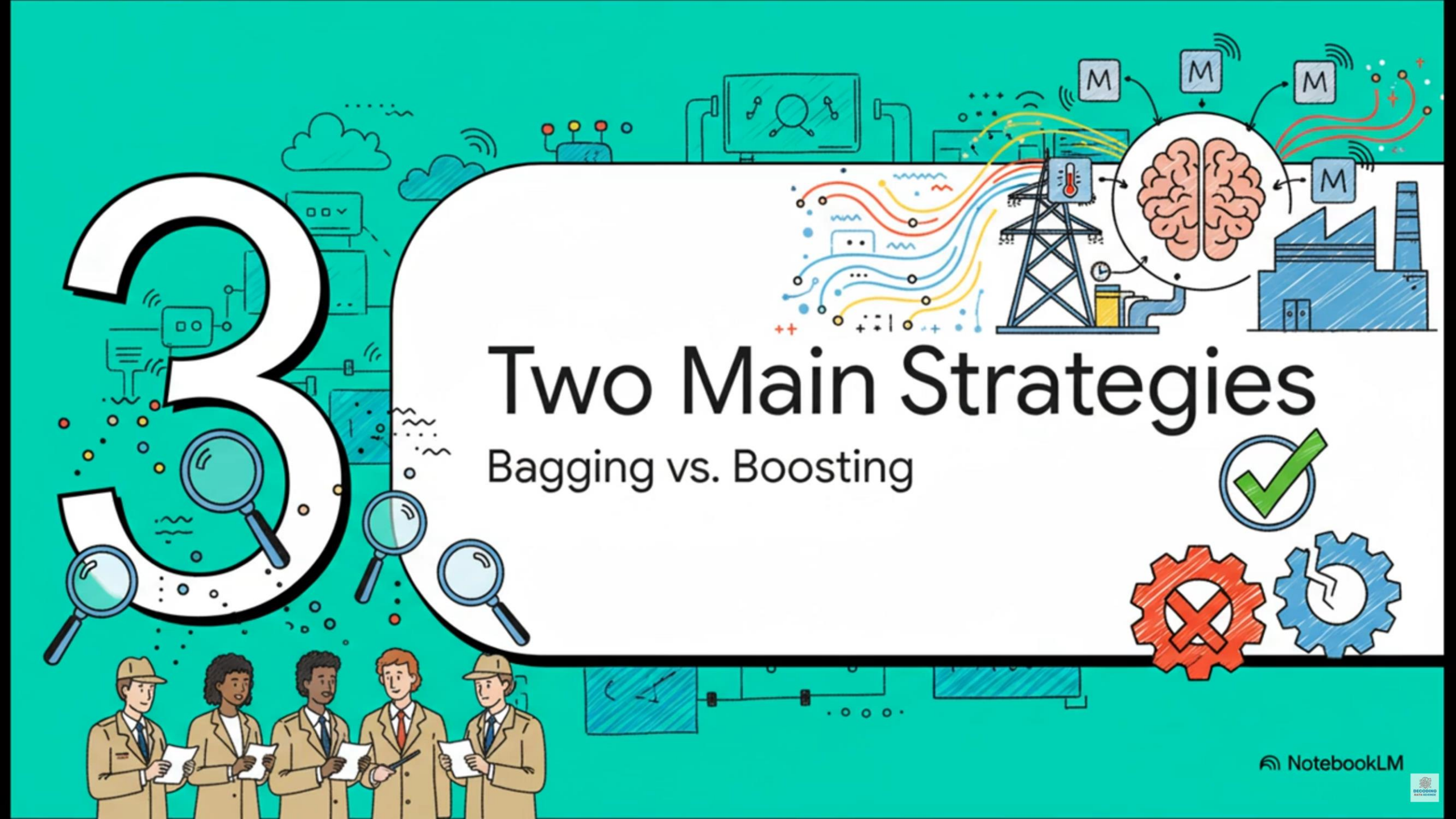
TEAM APPROACH

Benefits

HIGHER ACCURACY

MORE STABLE & TRUSTWORSTHY

MORE ROBUST TO NOISE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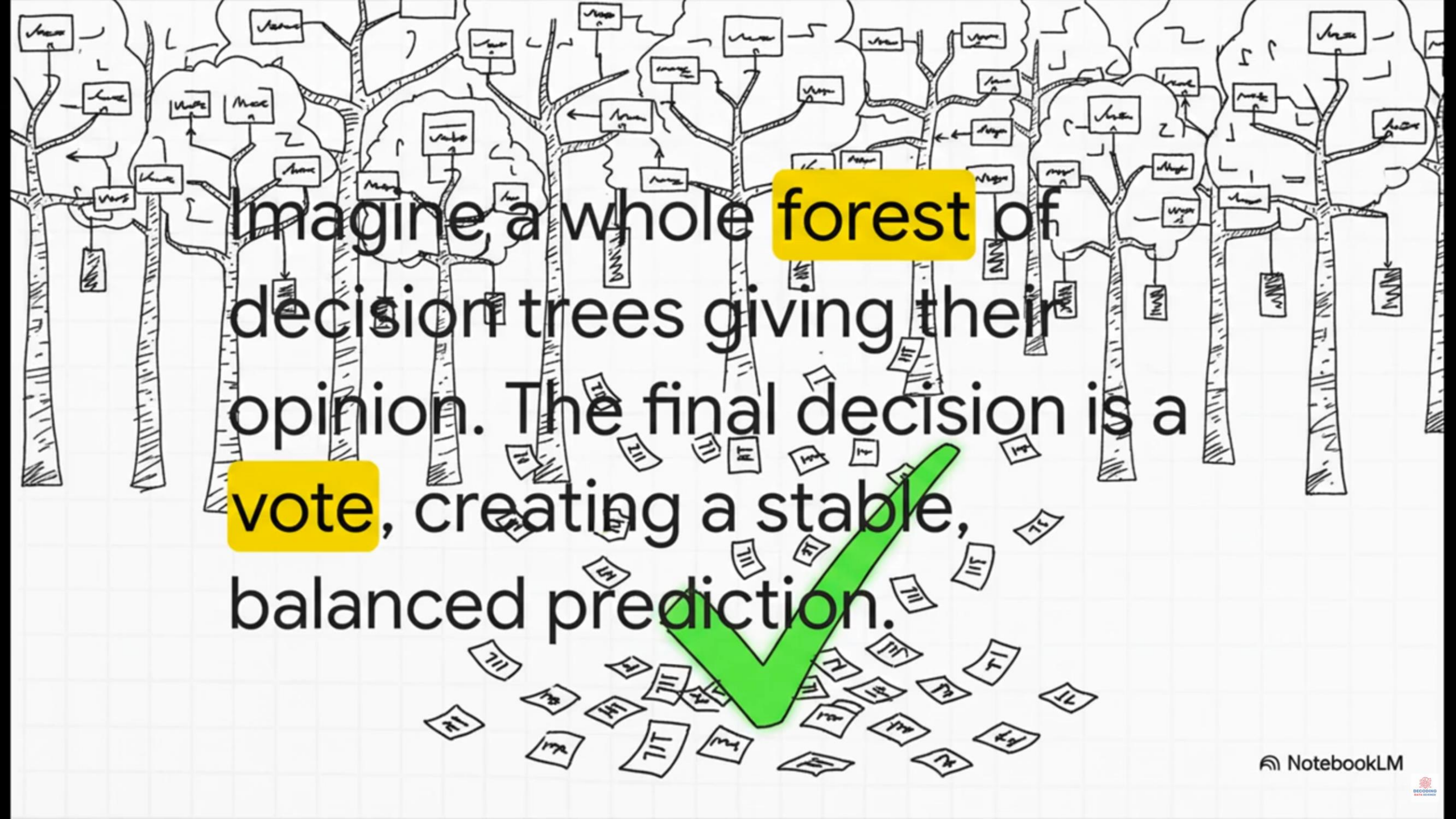
Two Main Strategies
Bagging vs. Boosting
NotebookLM

Bagging

Boosting


Imagine a whole forest of decision trees giving their opinion. The final decision is a vote, creating a stable, balanced prediction.
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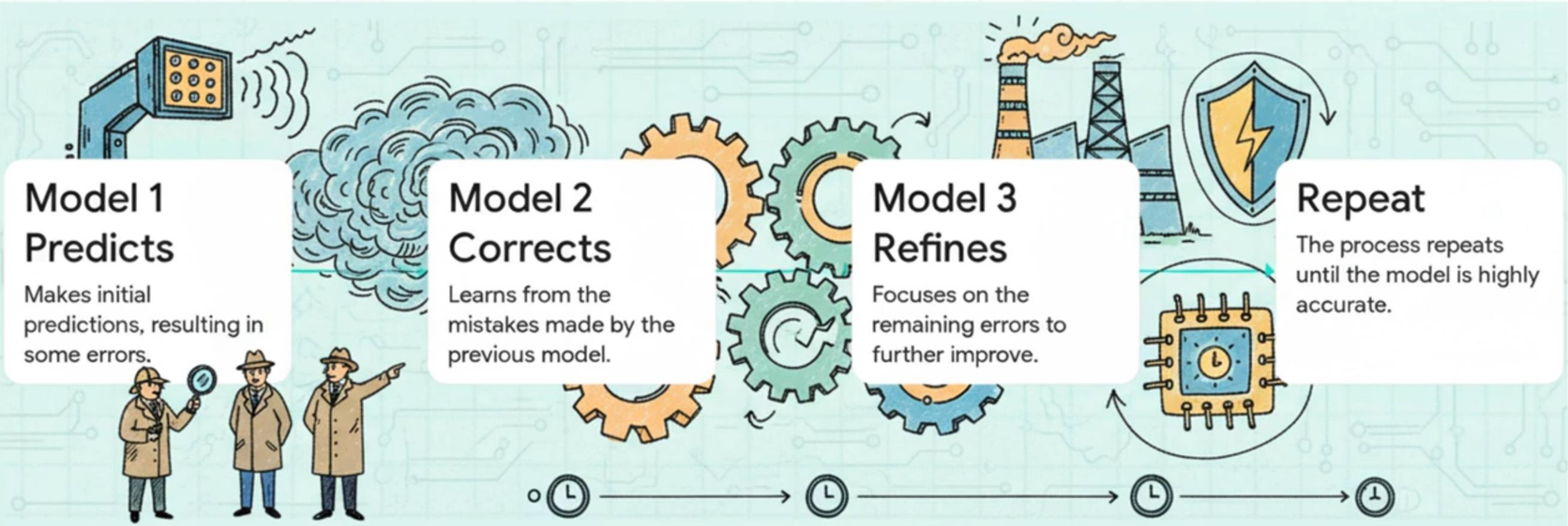
Gradient Boosting



Model 1 Predicts

Makes initial predictions, resulting in some errors.

Model 2 Corrects

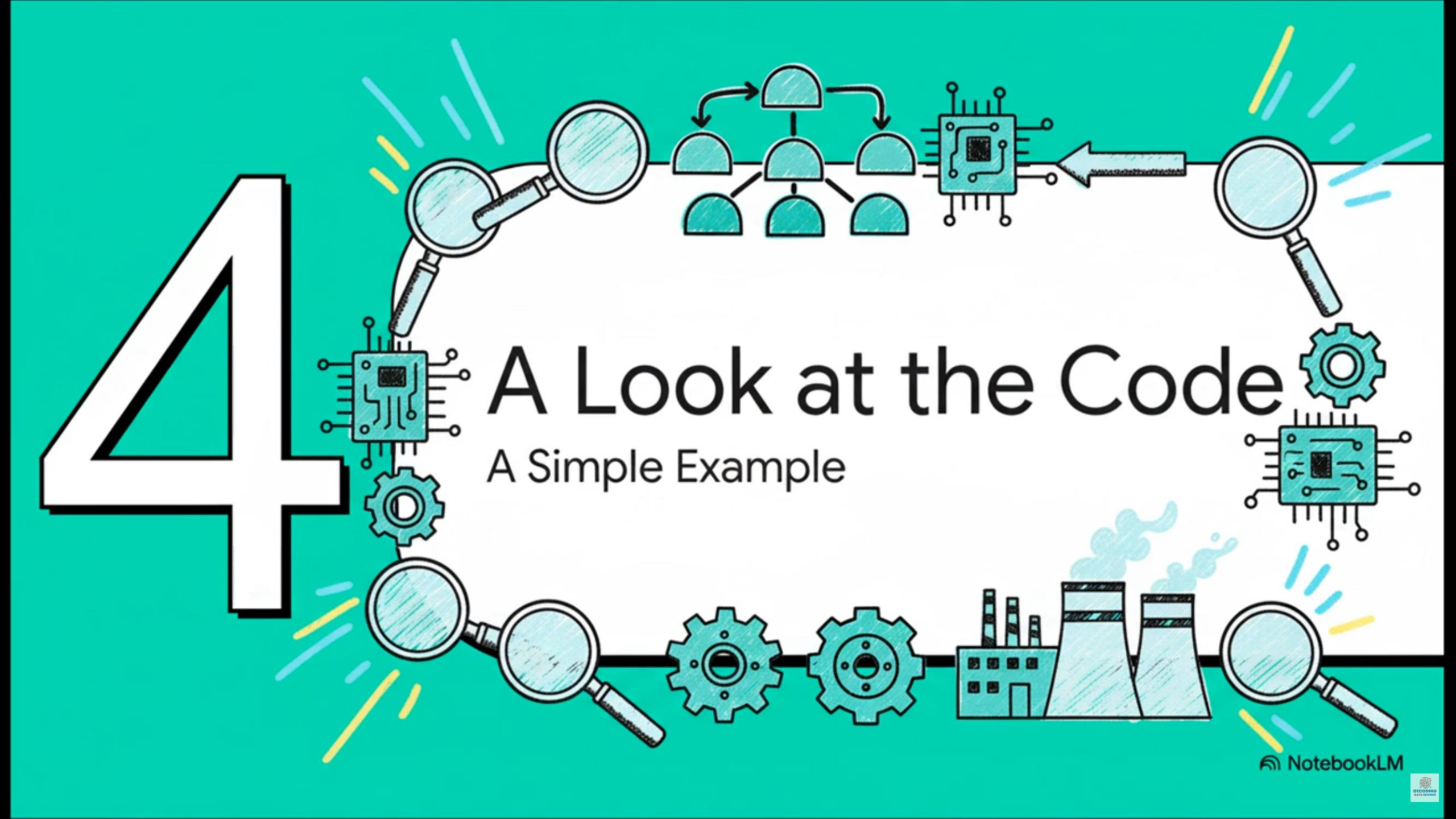
Learns from the mistakes made by the previous model.

Model 3 Refines

Focuses on the remaining errors to further improve.

Repeat

The process repeats until the model is highly accurate.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A Look at the Code
A Simple Example
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How the Code Works

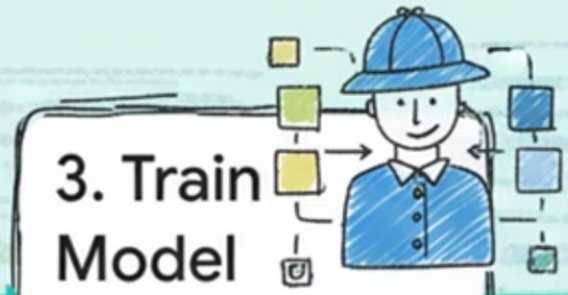
1. Generate Data

Create synthetic sensor data (temp, vibration, pressure).

2. Define Failure

Create a rule for what constitutes a 'failure' pattern.

3. Train Model



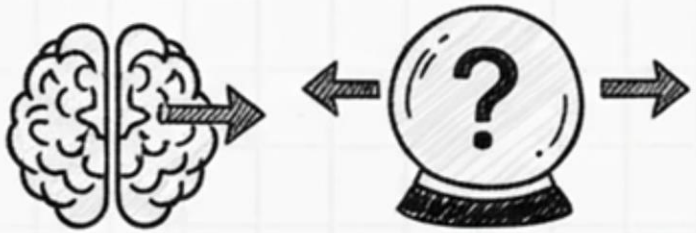
Build a Random Forest model to learn the failure pattern.

4. Test Performance

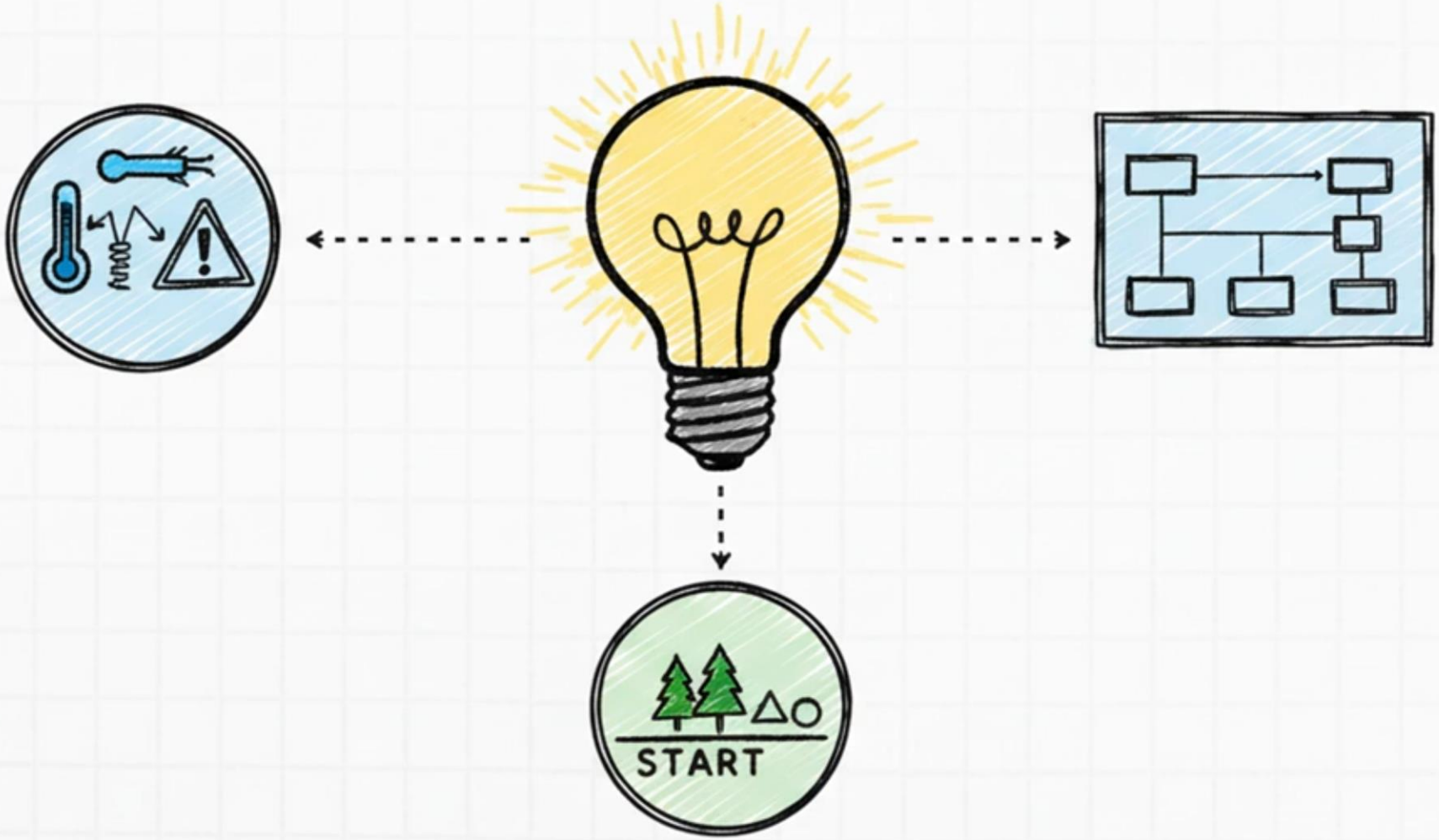
See how well the model predicts failures on new, unseen data.

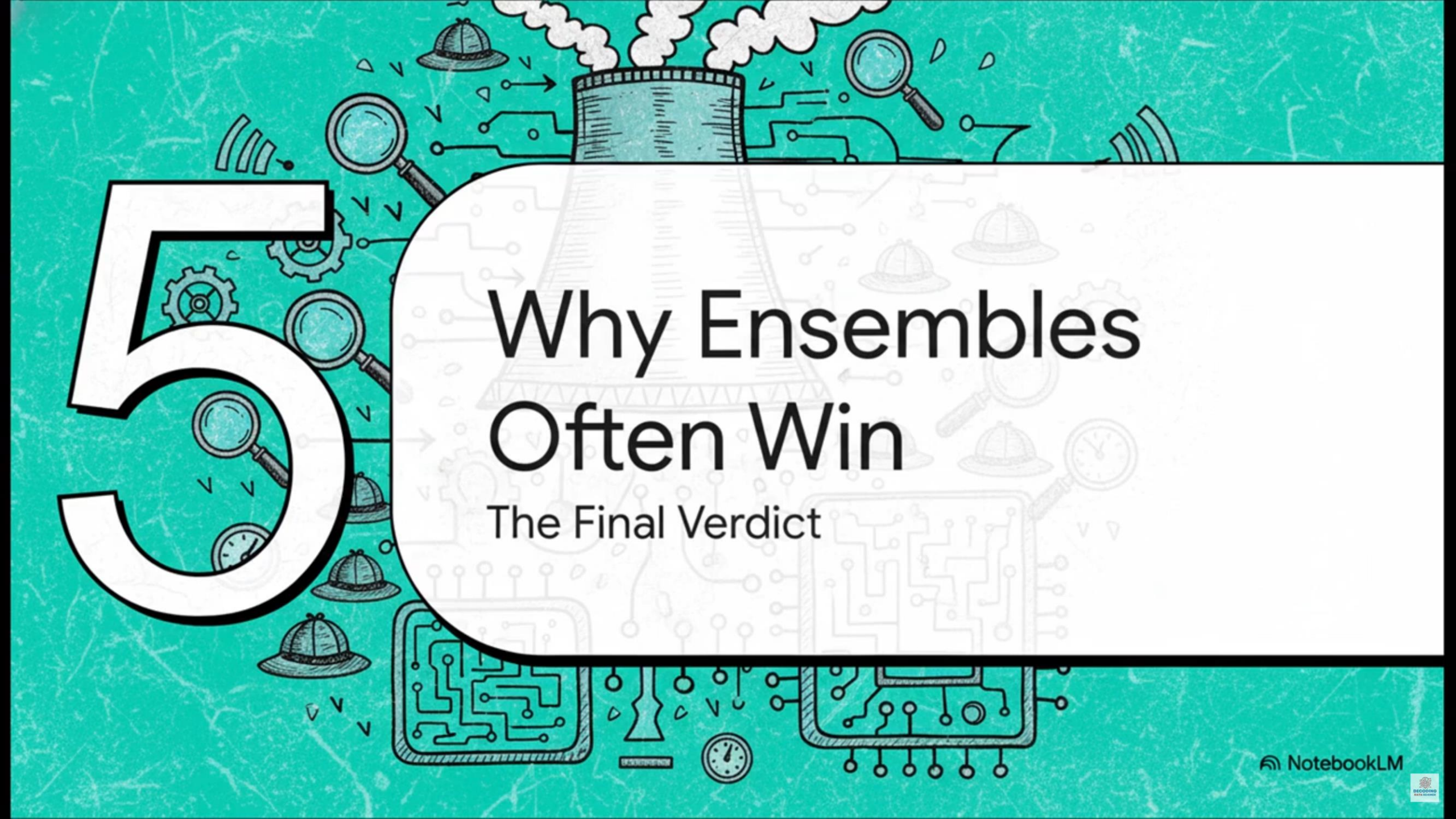
Key Code Lines

- `from sklearn.ensemble import RandomForestClassifier`
- `model = RandomForestClassifier(n_estimators=50)`
- `model.fit(X_train, y_train)`
- `y_pred = model.predict(X_test)`



What This Teaches Us

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Why Ensembles Often Win
The Final Verdict
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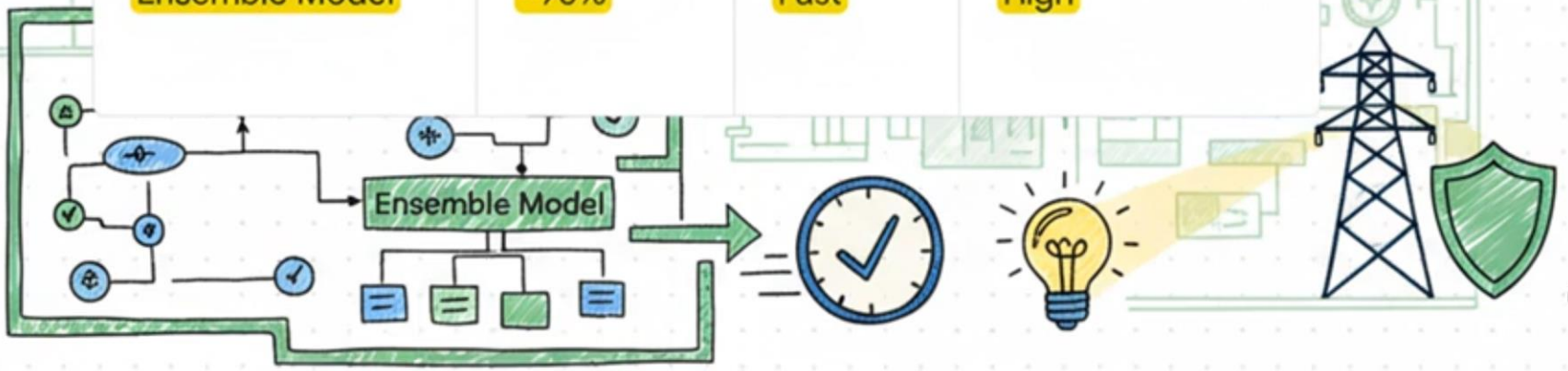
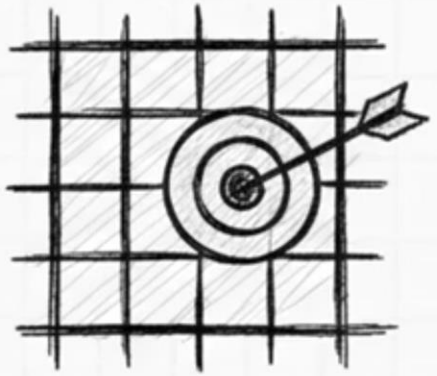
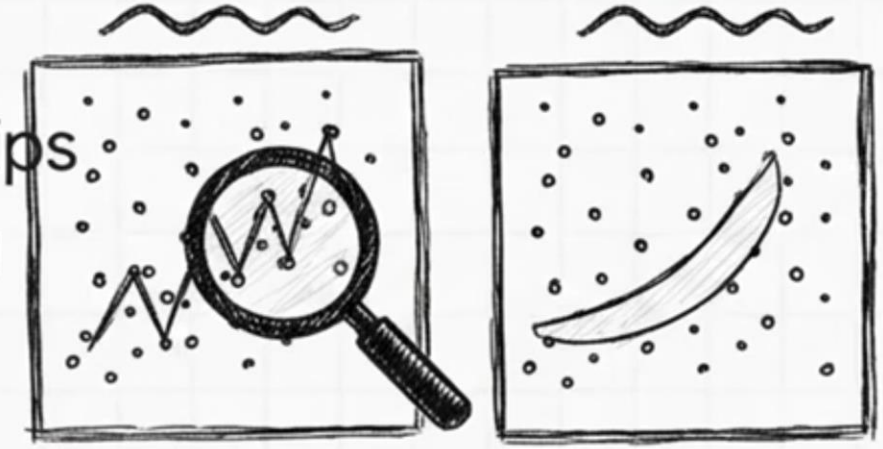
Model	Accuracy	Speed	Interpretability
SVM	~95%	Medium	Low
Neural Network	~95%	Slow	Very Low
Ensemble Model	~95%	Fast	High



Key Technical Benefits

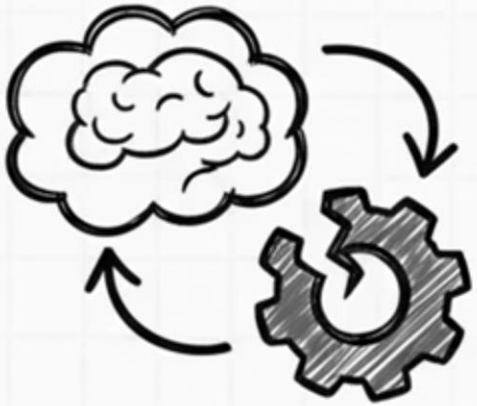


- High accuracy on tabular sensor data
- Excellent at handling non-linear relationships
- Reduces variance and prevents overfitting
- Works well even with limited data



Overfitting

Good Fit



The Final Verdict

Combining simple models to create one strong predictor