Machine Learning

Session 3 - Decision trees & Ensemble methods


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introduction-to-data-science

Introduction

What did we do last time?

Course outline

Intro to ML course

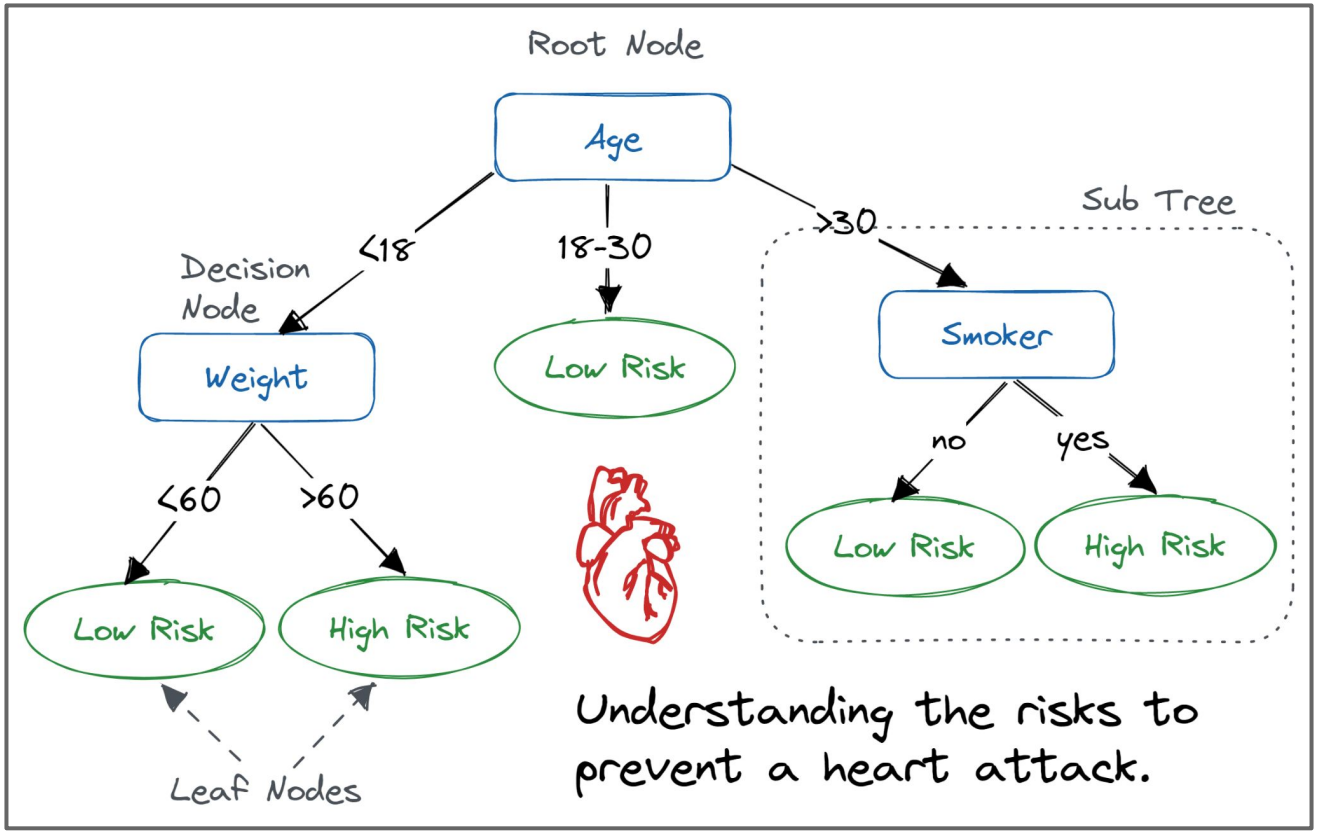
Session 1: Introduction to ML & Regression

Session 2: Supervised classification

Session 3: Decision trees & Ensemble methods

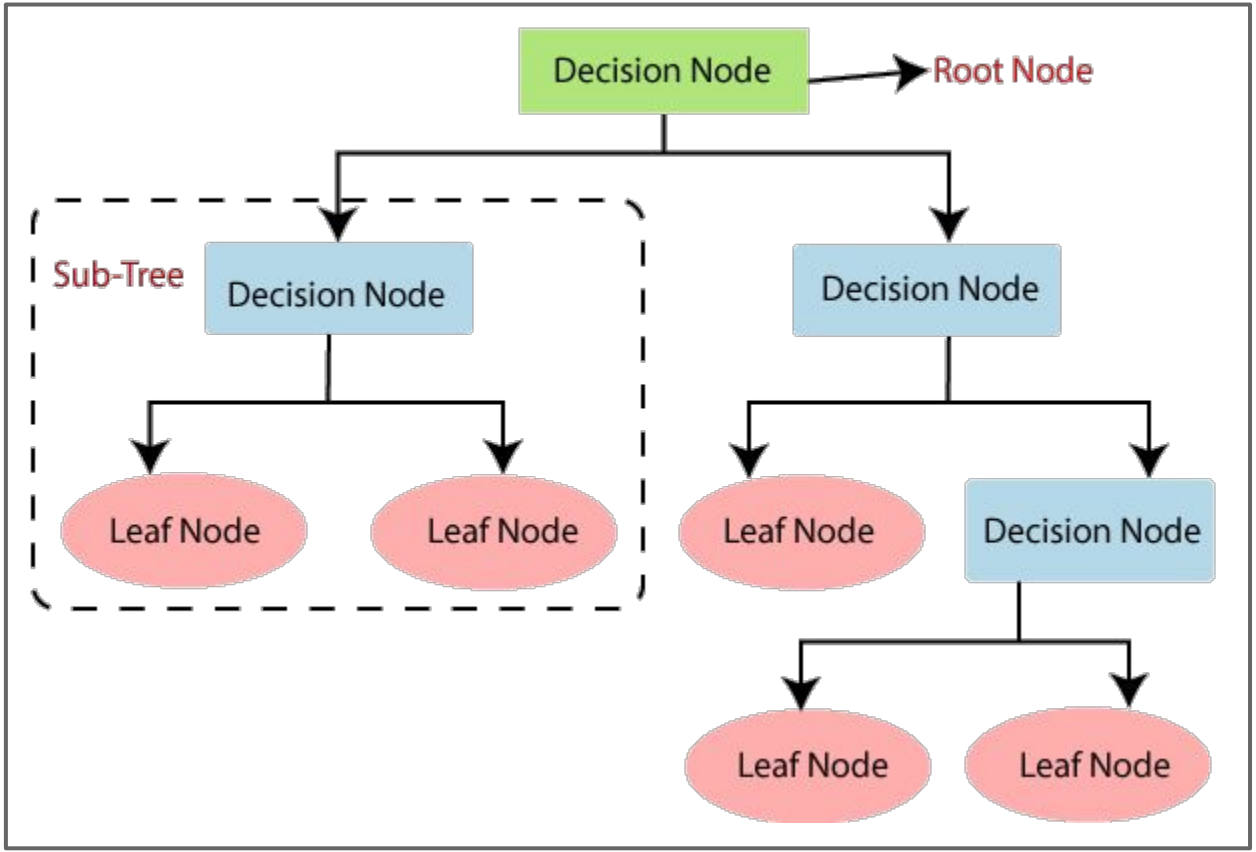
Deep Learning

What are decision trees?



Decision trees - Example

Image source



Vocabulary

Image source

Definition

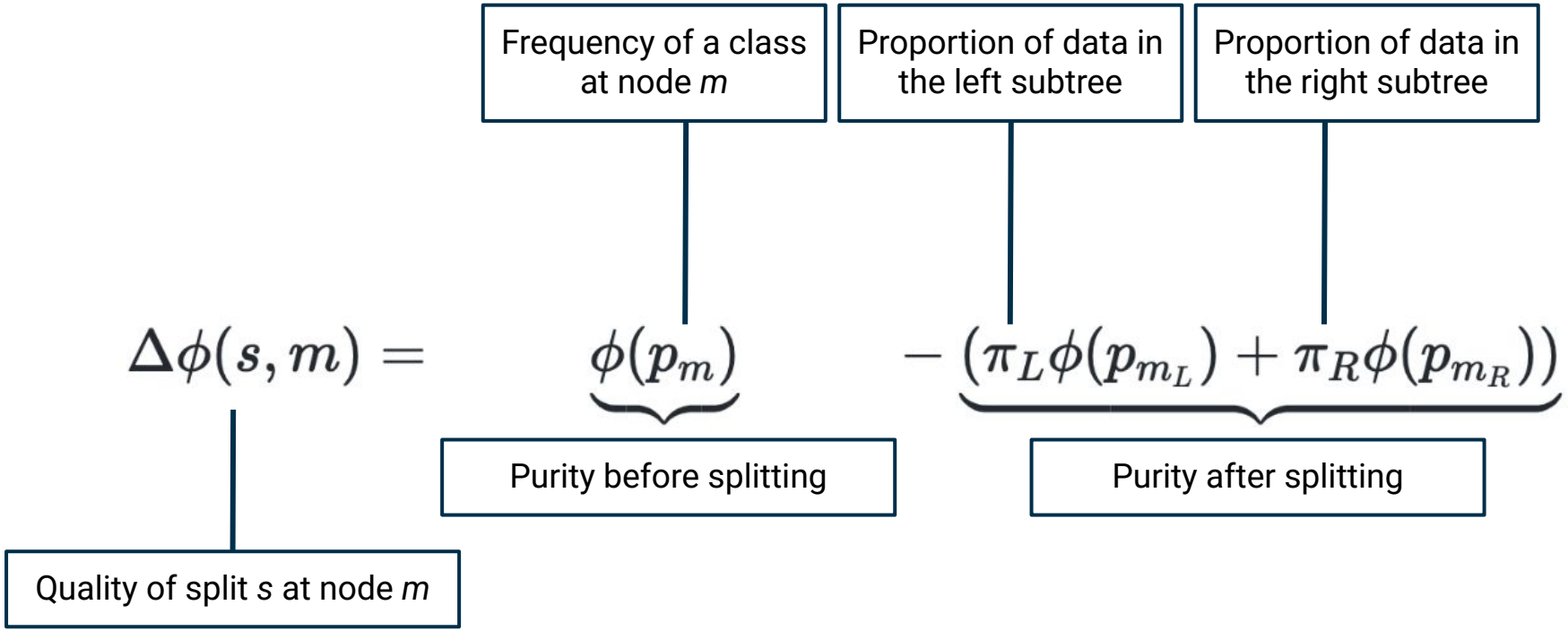
Purity of a node

A node is 100% pure when all of its data belongs to a single class.

It is 100% impure when it contains the same proportion of each class.
(e.g. 50/50 for binary classification)

Several functions can be used to compute the impurity of a node:

- **Gini Index**
- **Cross-entropy**
- **Misclassification error**



Different splits are tested recursively to find the best partitioning

Strength and weaknesses of decision trees

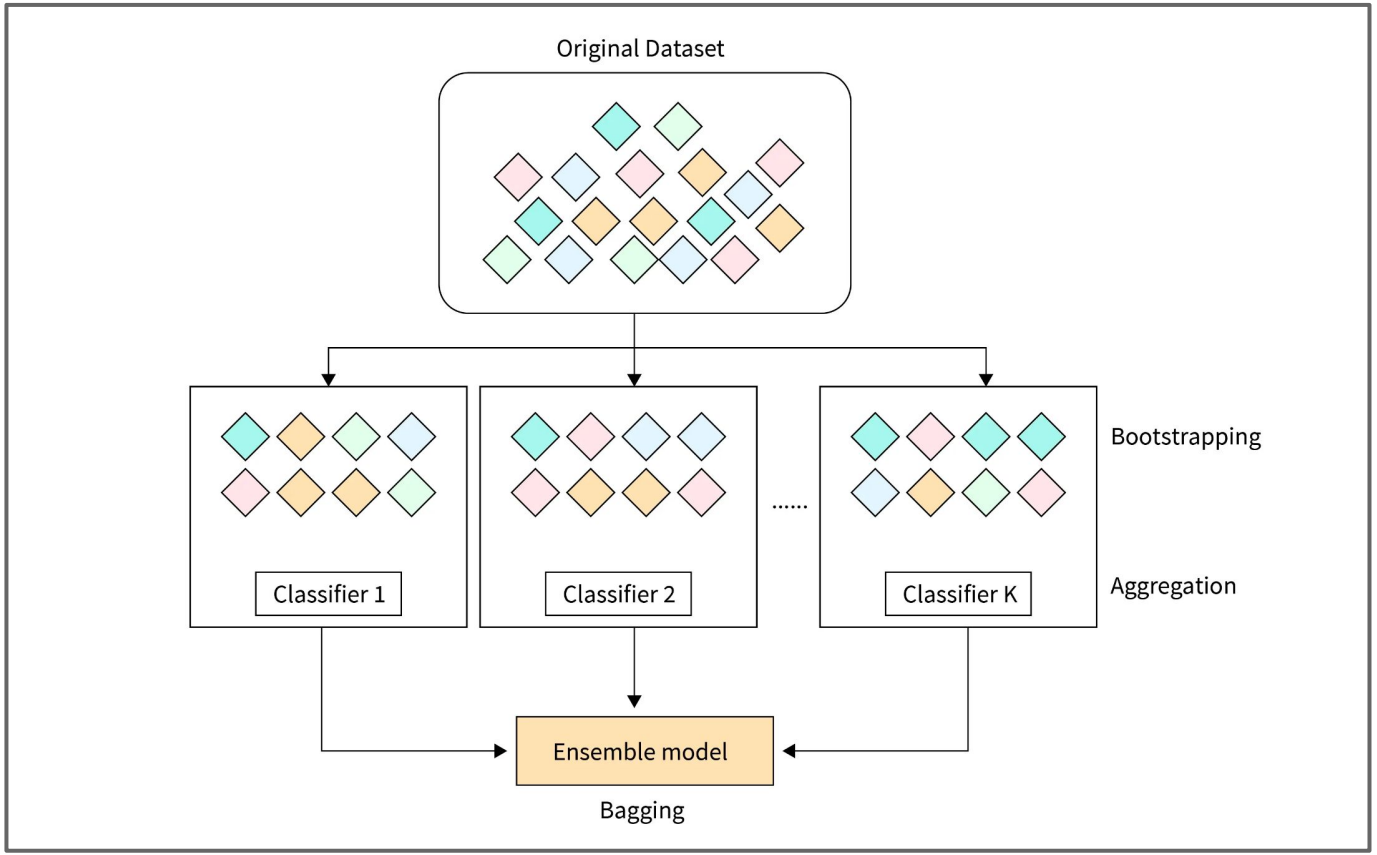
Strengths

- Flexible (few hypotheses)
- Easy to interpret (explicit rules)
- Non-linear (complex decision boundaries)

Weaknesses

- Prone to overfitting
- Unstable to noise
- Expensive on large datasets

Ensemble methods

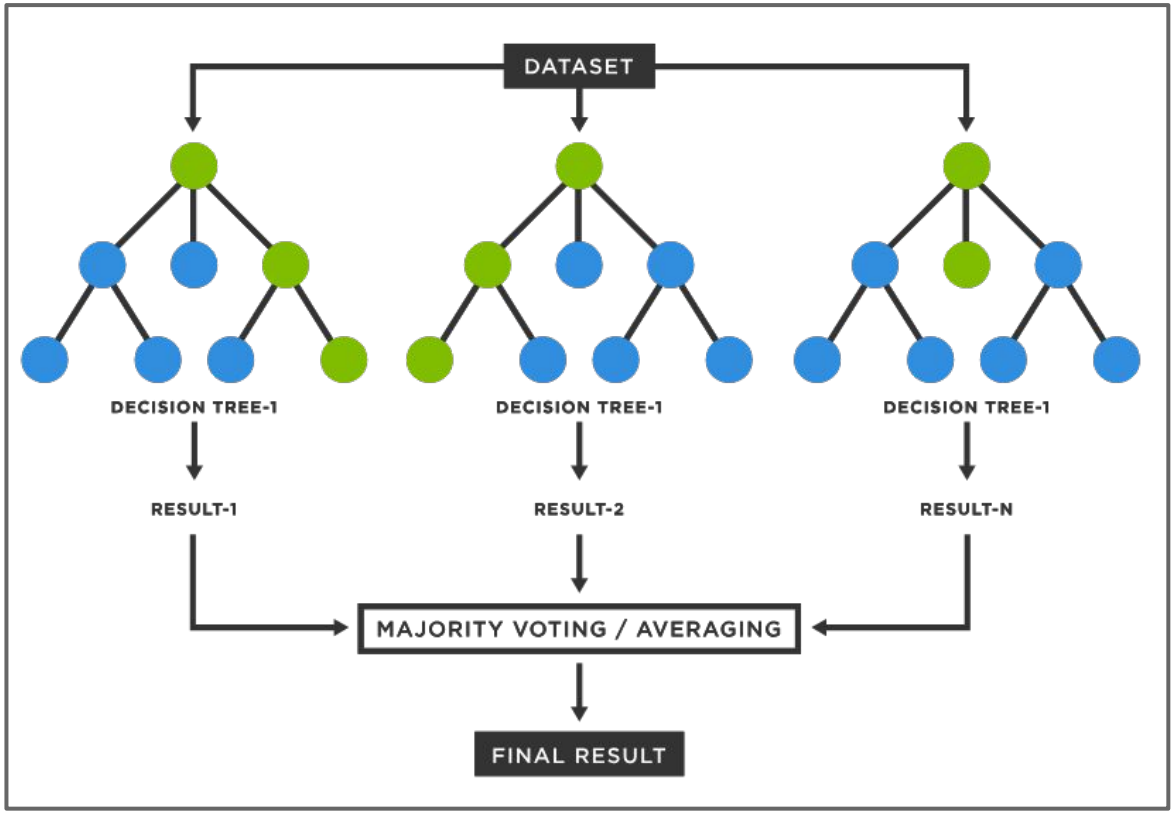


Bootstrapping
Recombining existing data to create datasets

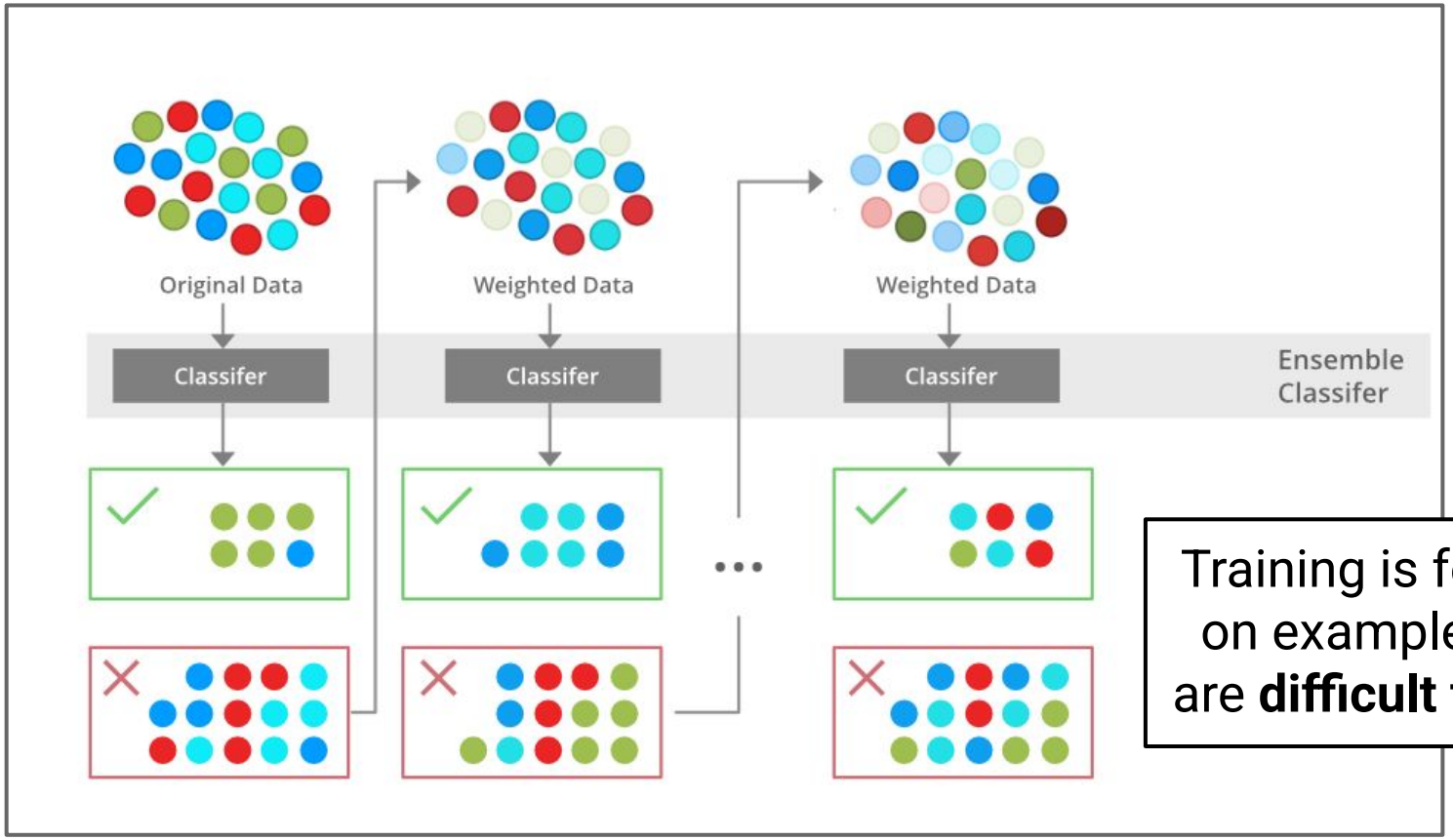
Aggregating
Training an algorithm for each dataset

Bagging (Bootstraping + Aggregating)

Image source



The principle is similar to bagging, except **trees are built upon random subsets of features**



Training is focused on examples that are **difficult to learn**

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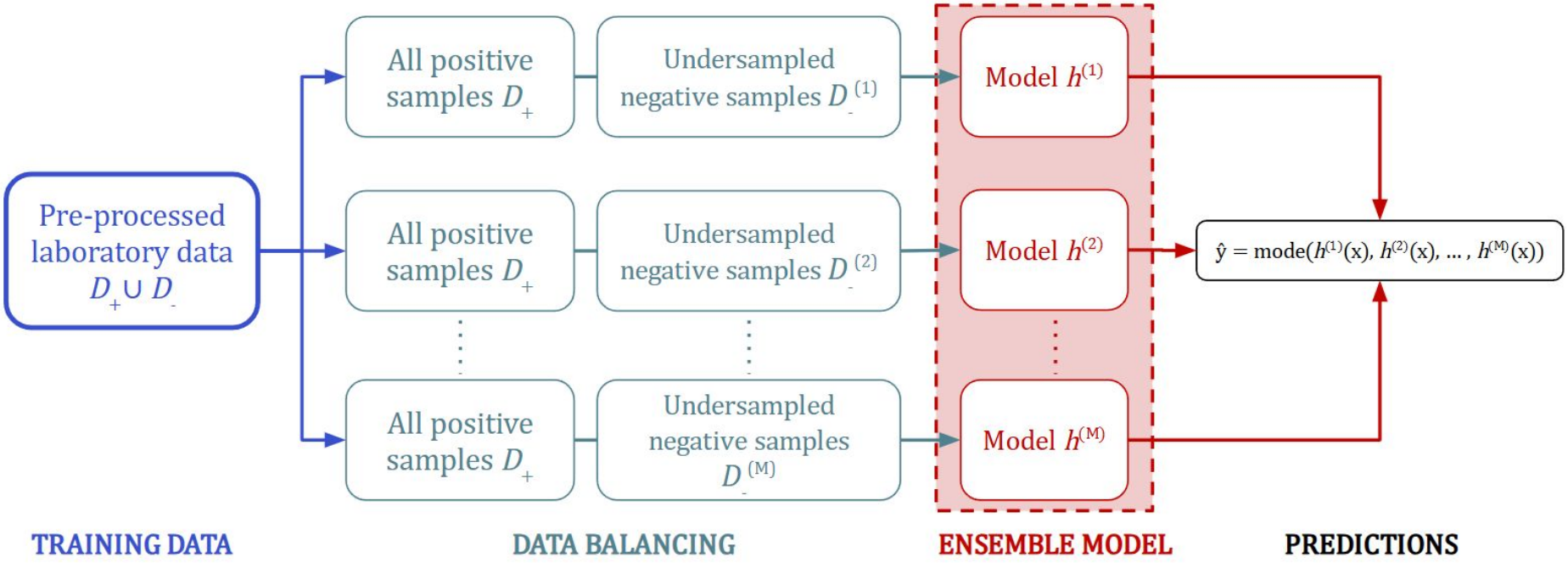

EasyEnsemble (example application to laboratory data)

Strength and weaknesses of ensemble methods

Strengths

- Tends to increase accuracy
- Robust to noise
- Helps reduce overfitting

Weaknesses

- Requires more ressources
- Makes interpretation more difficult

Practical work

The notebook contains all the necessary instructions

Debrief

Debrief

What did we learn today?

What could we have done better?

What are we doing next time?

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