



# **CIS 635 Knowledge Discovery & Data Mining**

**ML Models: Ensemble Learning**



# Ensemble Learning/Meta Learning

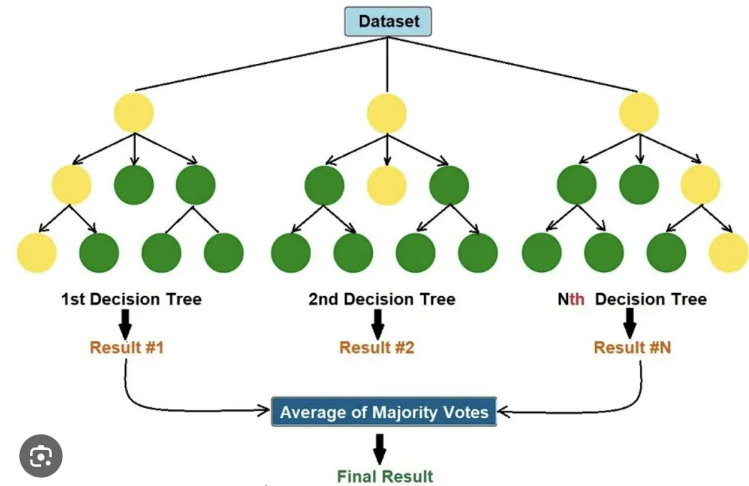


# Ensemble Learning/Meta Learning

- Ensemble (more than one model)
  - Bagging
    - Averaging (RF)
    - Reduces Variance
  - Boosting
    - Gradual improvement over weak learners (Adaboost/XGBoost)
    - Reduces Bias??

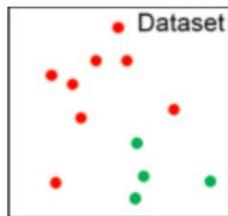
# Random Forest

- Instead of one, we have many (but finite) Trees

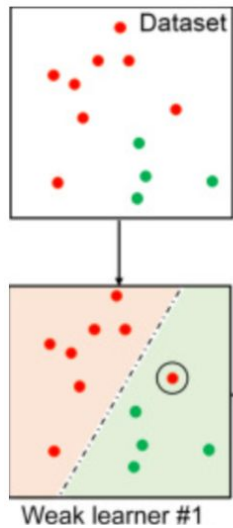


# Boosting

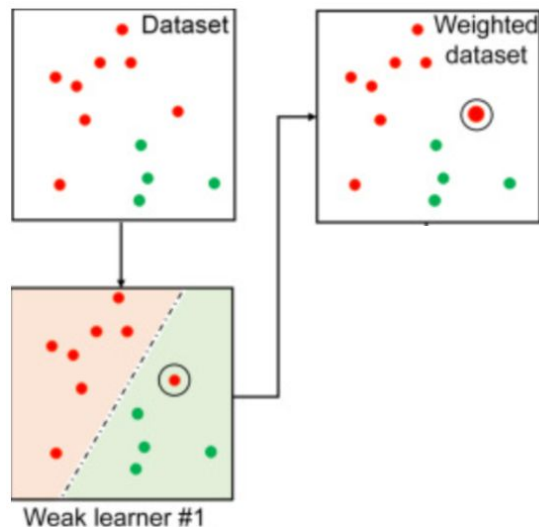
- Combination of some weak models
- Power of many



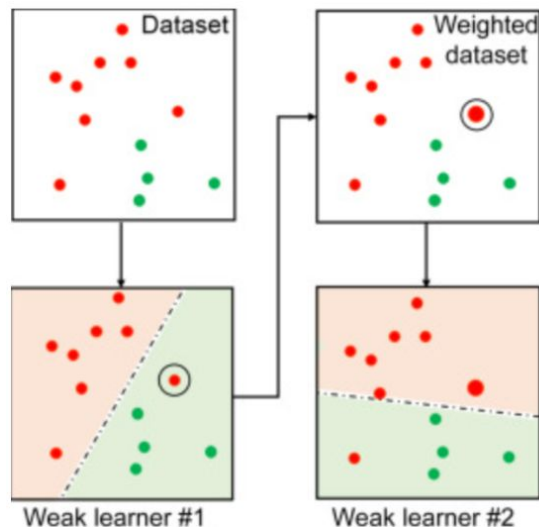
# Boosting



# Boosting

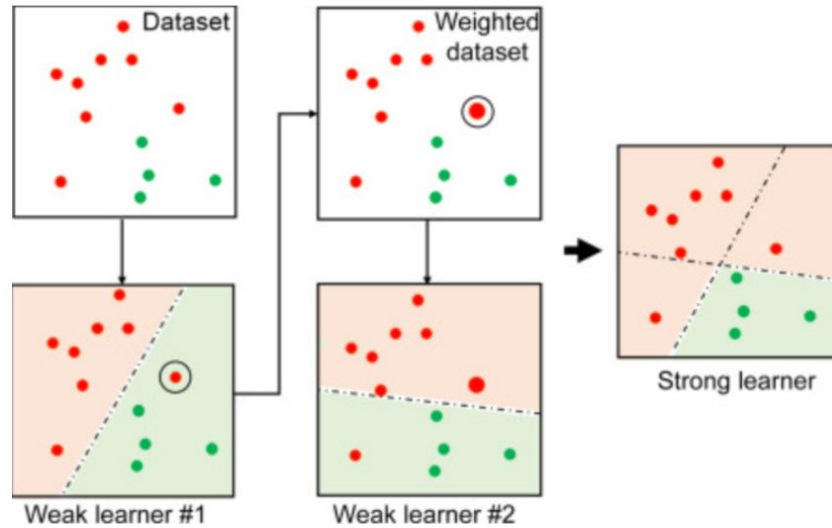


# Boosting

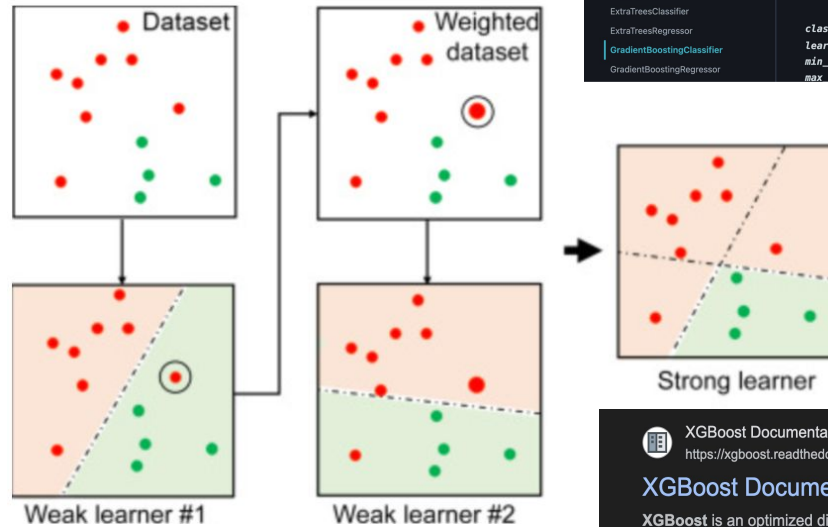




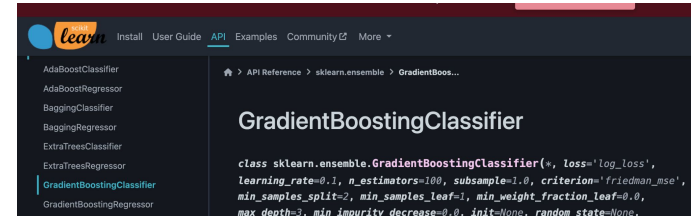
# Boosting



# Boosting



[img src](#)



XGBoost Documentation  
<https://xgboost.readthedocs.io>

## XGBoost Documentation — xgboost 2.1.1 documentation

XGBoost is an optimized distributed gradient boosting library designed to be highly efficient, flexible and portable. It implements machine learning algorithms ...

[Introduction to Boosted Trees](#) · [XGBoost Parameters](#) · [Get Started with XGBoost](#)



## Notebook extension/presentation

- See notebooks section (Blackboard)