



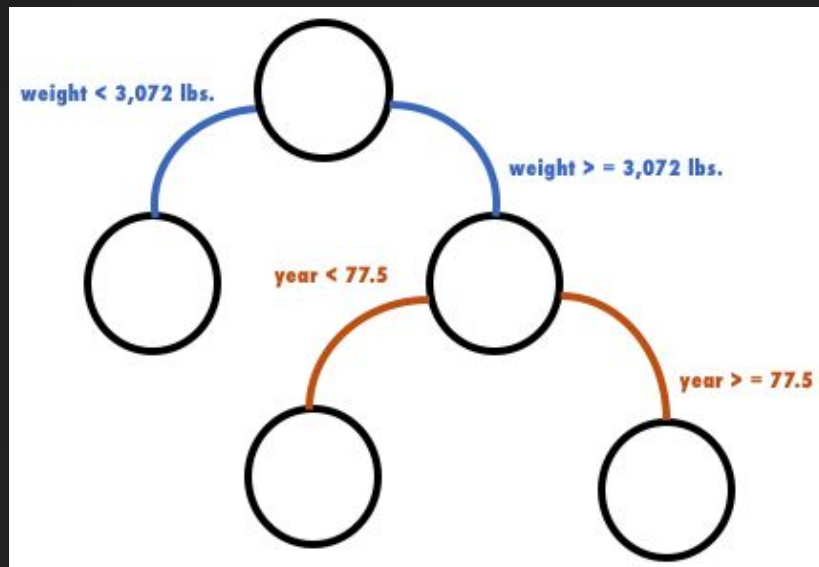


/ Tree Models

Tree models

/ Tree models are based on if-else decisions. This kind of models needs less preprocessing than models based on multiplications. Tree models are:

- Decision trees
- Random Forest
- Extremely Randomized Trees
- Adaboost
- Gradient Boosting
 - XGBoost
 - LightGBM
 - Catboost



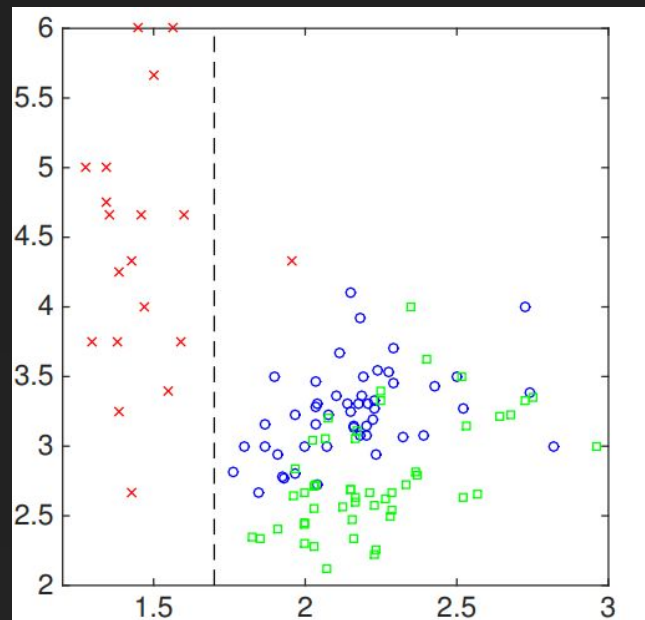
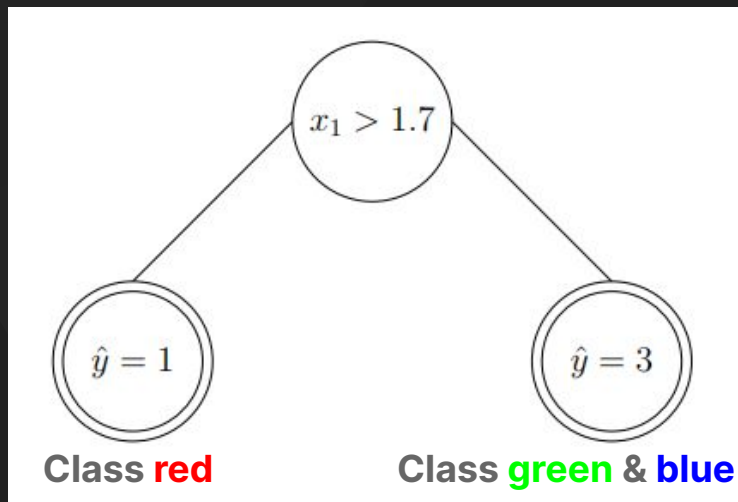


Decision Tree

For classification

```
from sklearn.tree import DecisionTreeClassifier
```

/ Tree models splits the “variable space” in regions (like boxes).



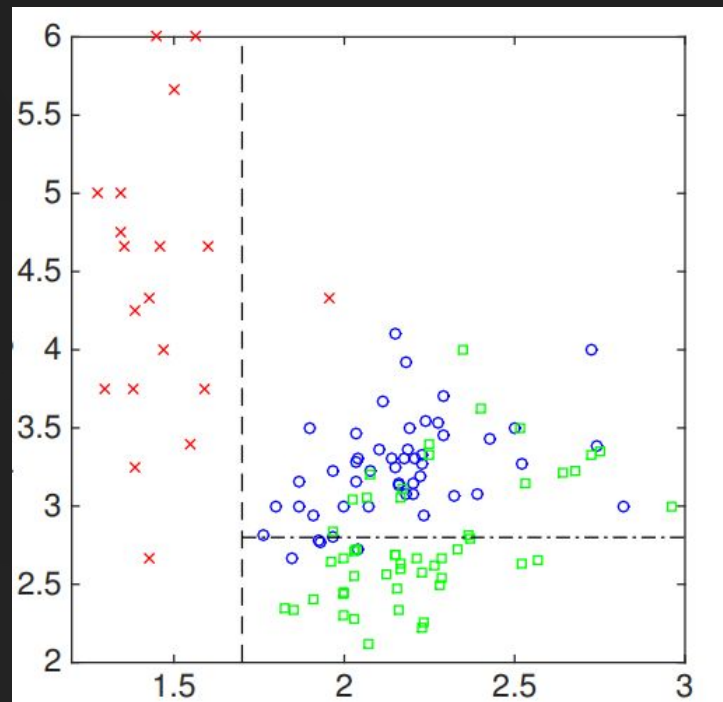
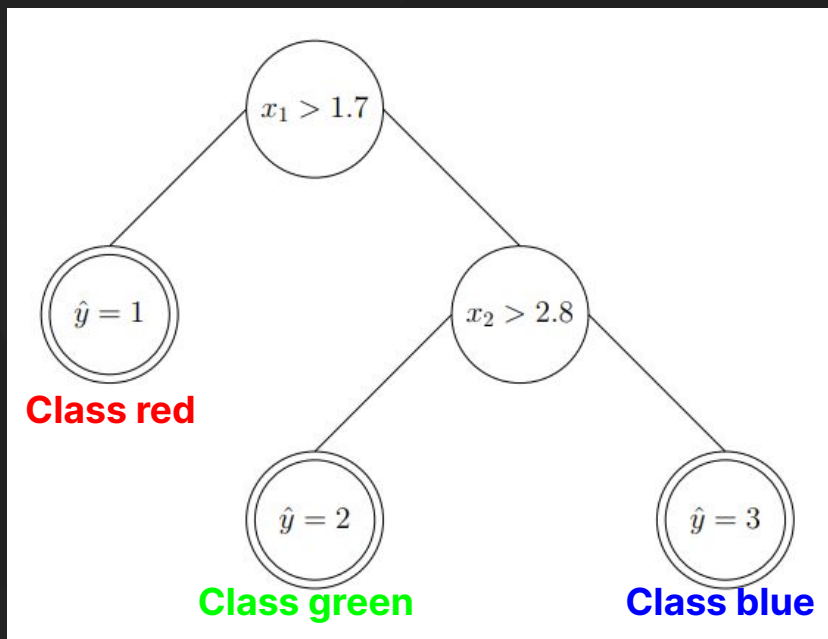


Decision Tree

For classification

```
from sklearn.tree import DecisionTreeClassifier
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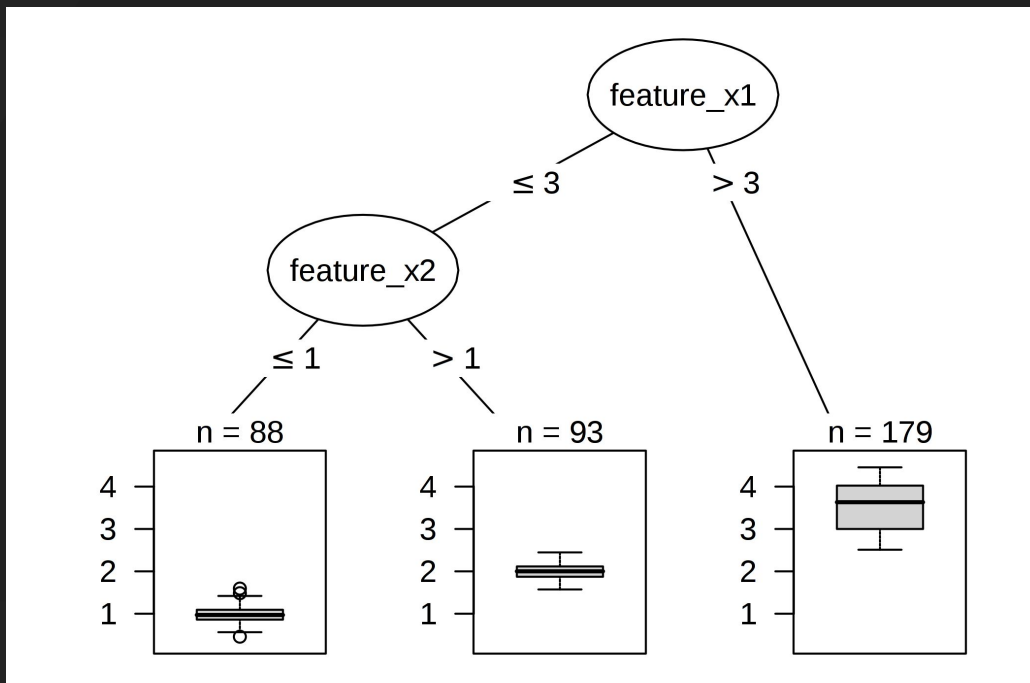


Decision Tree

For regression

```
from sklearn.tree import DecisionTreeRegressor
```

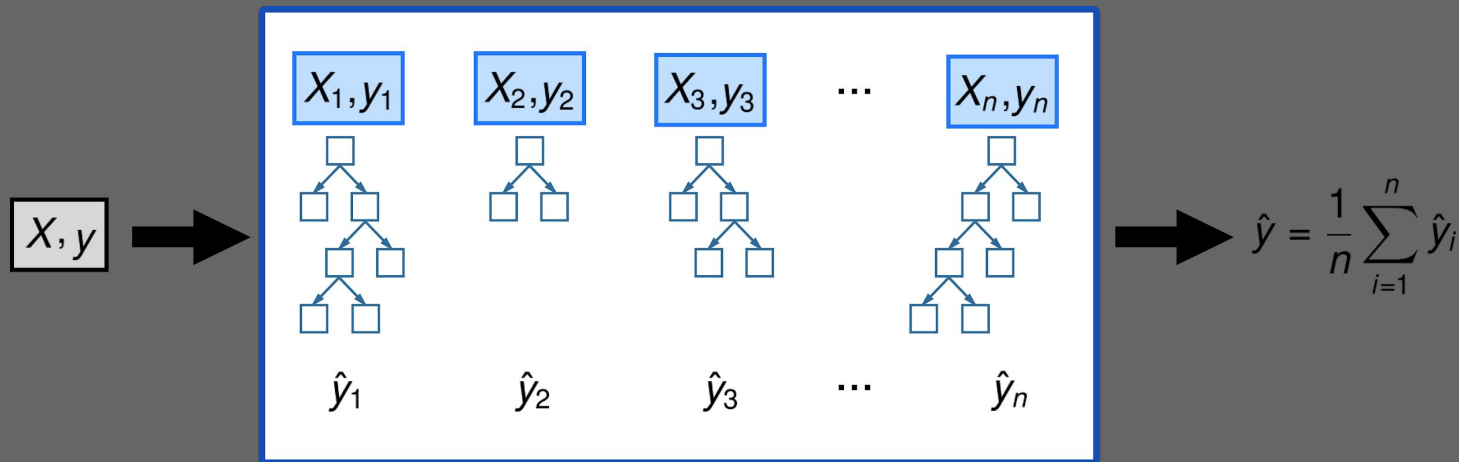
/ Each leaf of the tree is a **fixed value** (not a class)





Random Forest (RF) & Extremely Randomized Trees

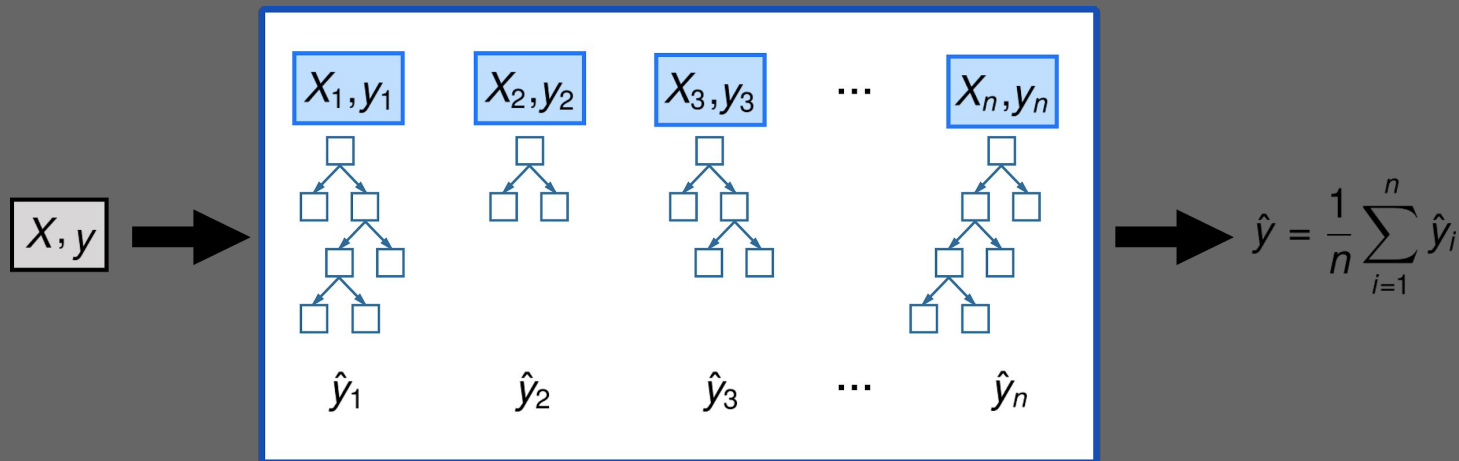
/ Each tree is constructed with a random subset of the training data (by picking not all the variables and not all the samples). The final prediction is an average of all the trees.





Random Forest (RF) & Extremely Randomized Trees

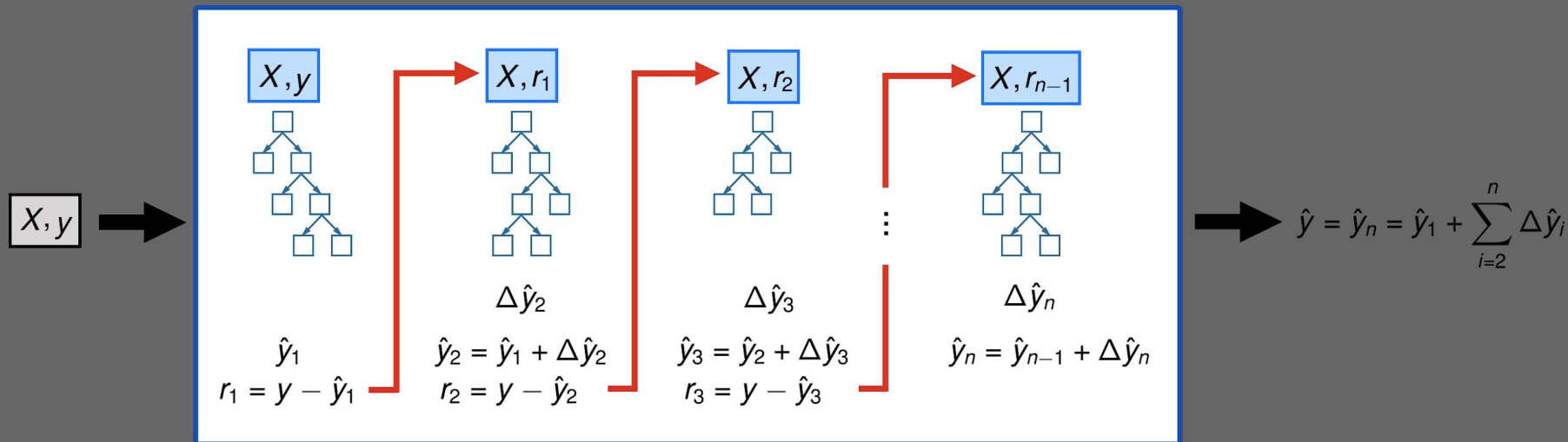
```
from sklearn.ensemble import RandomForestClassifier, RandomForestRegressor  
from sklearn.ensemble import ExtraTreesClassifier, ExtraTreesRegressor
```





Gradient Boosting (GBM)

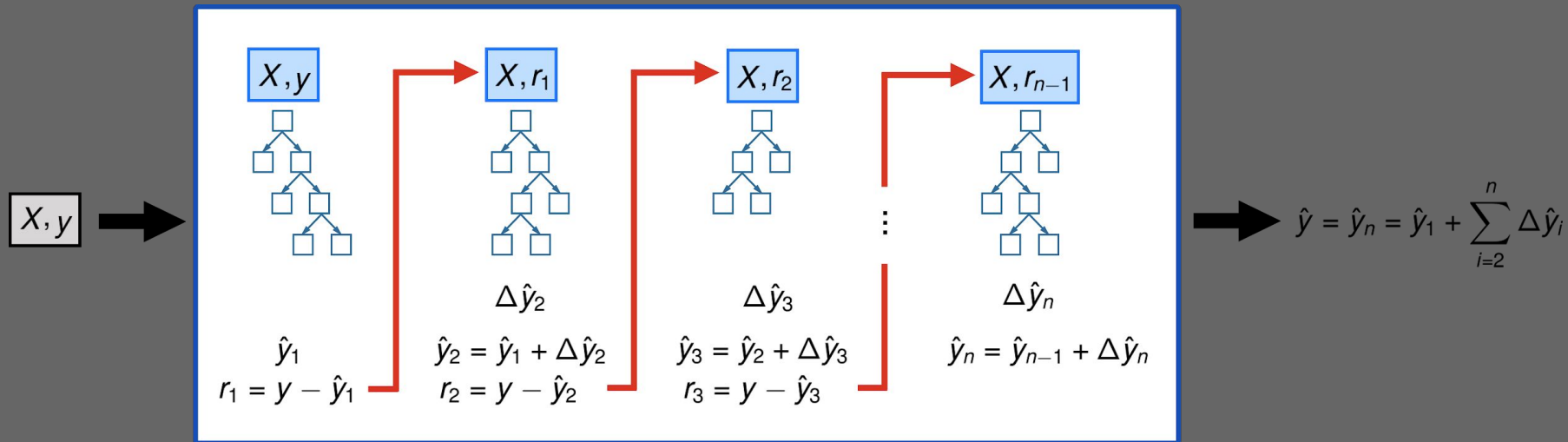
/ Every new tree improves the error of the previous trees.





Gradient Boosting (GBM)

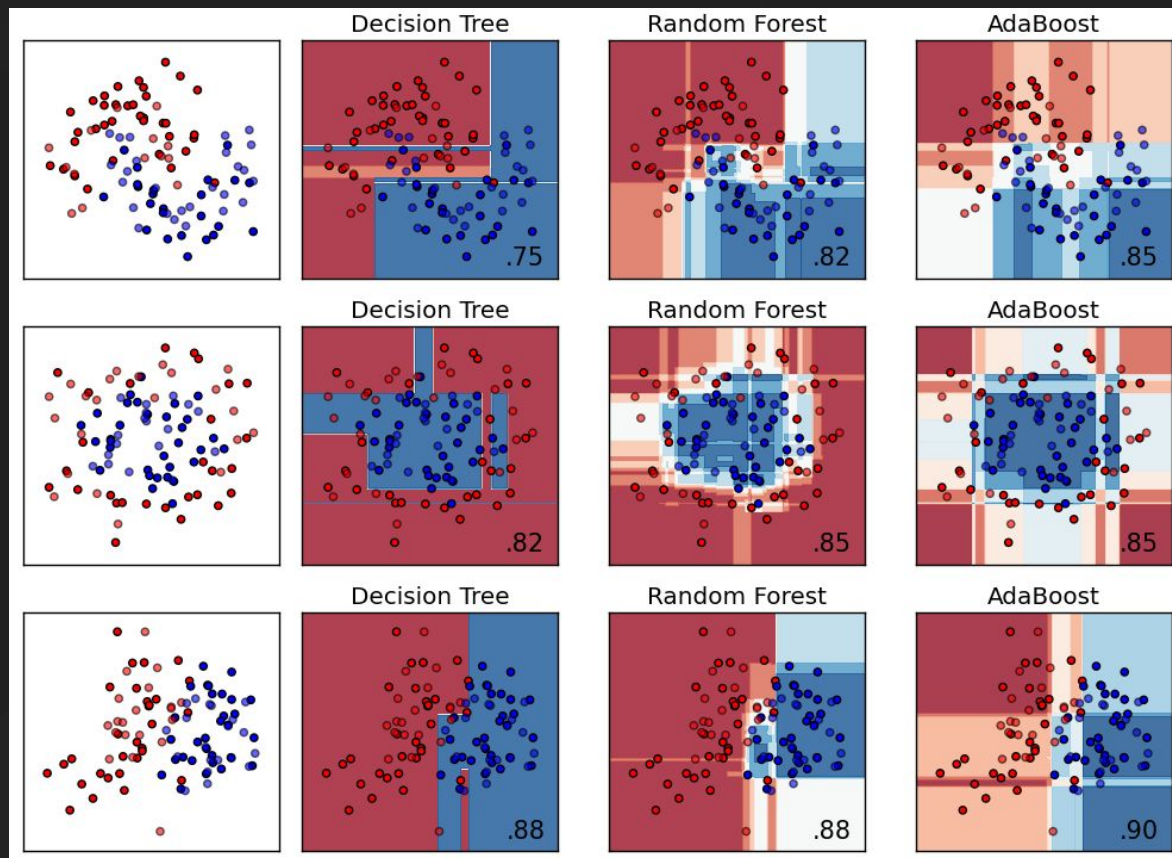
```
from sklearn.ensemble import GradientBoostingClassifier, GradientBoostingRegressor
from xgboost import XGBClassifier, XGBRegressor
from lightgbm import LGBMClassifier, LGBMRegressor
from catboost import CatBoostClassifier, CatBoostRegressor
```



Decision boundary

/ Tree models always have perpendicular (90 degrees) boundaries (like boxes)

Adaboost and GBM are very similar models.

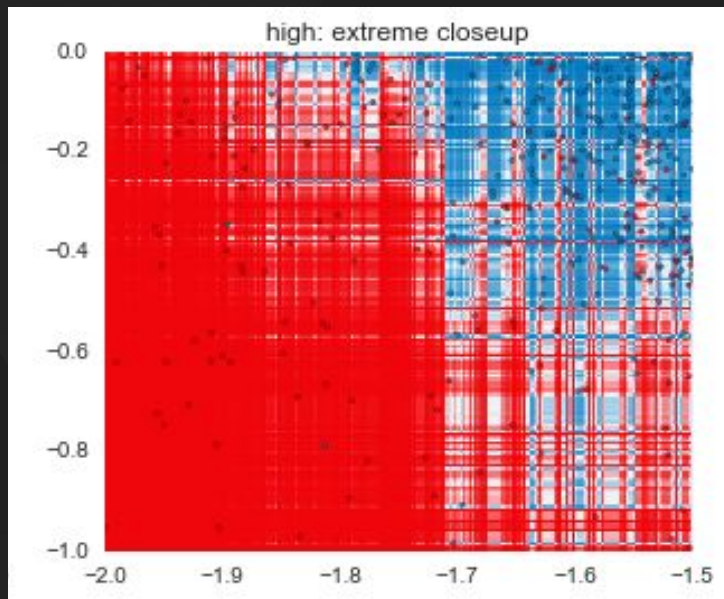




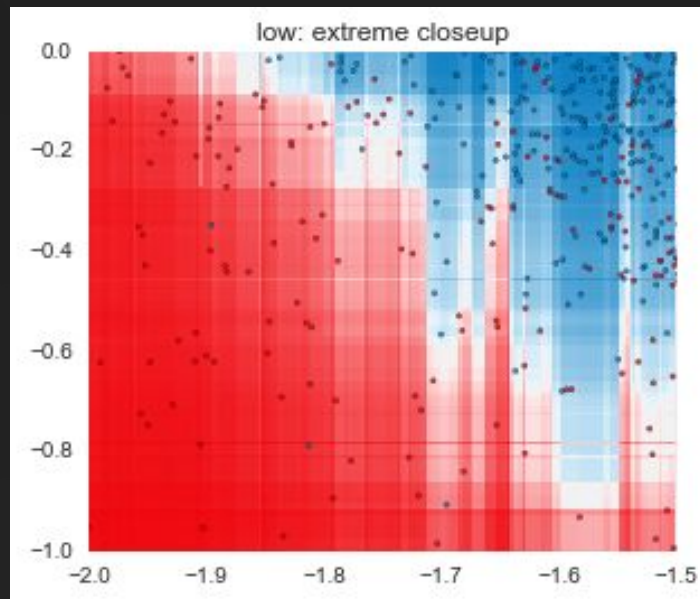
Decision boundary

/ Hyperparameter tuning is very important

Bad tree (overfitting)



Good tree





GBM Hyperparams

/ Hyperparameter tuning is very important

- Number of trees: 100...1000
- Maximum tree depth: 2...10
- % of rows used to build the tree: 80...90
- % of feats used to build the tree: 80...90
- Learning Rate: 0...1 (the lower the better, but slower. Try a log scale)



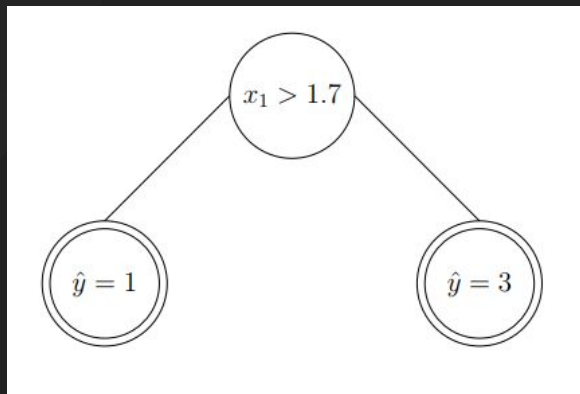
/ Preprocessing

The rule of thumb is:

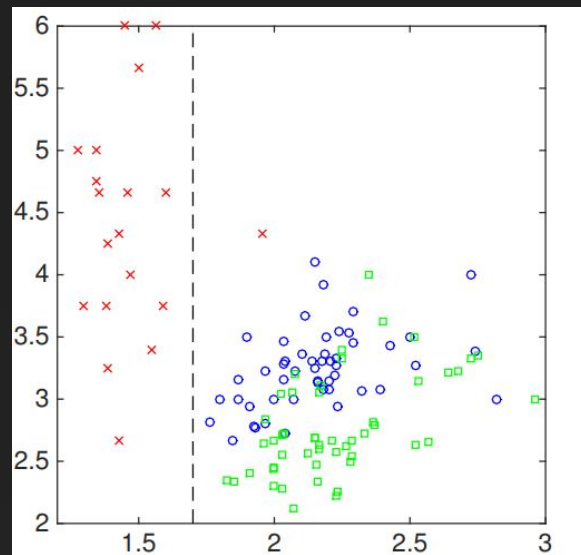
- Numerical variables: **Do nothing**
- Categorical variables: **Ordinal encoding**
 - For high cardinality (>1000 categories): **Binary encoding**

Numerical variables

/ Numerical features does not need any scaling or normalization. Because the tree finds an optimal threshold to split by.



Between 0 and 3: Finds 1.7 as the threshold



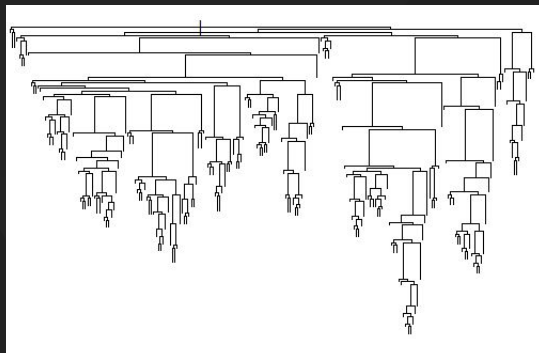


One Hot Encoding

[illegible]

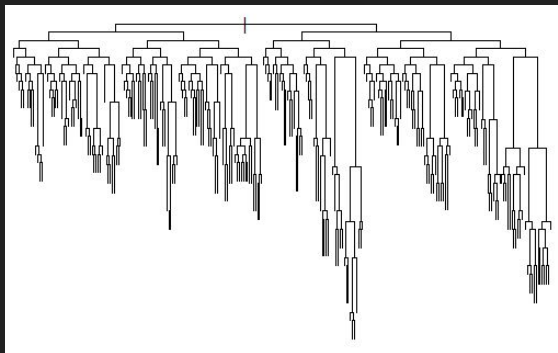
Categorical variables

Ordinal enc. (good)



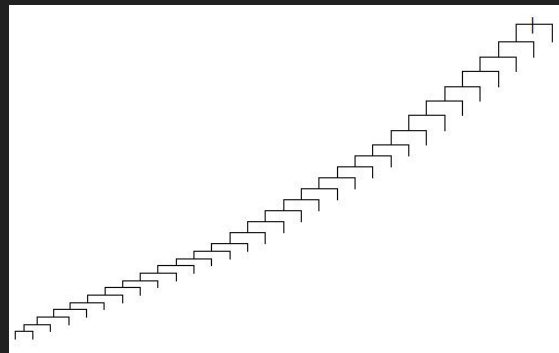
Good for small cardinality
(less than 1000 categories)

Binary enc. (good)



Good for big cardinality
(more than 1000 categories)

One Hot Enc. (Bad)



[Reference](#)



/ Q&A

What are your doubts?

