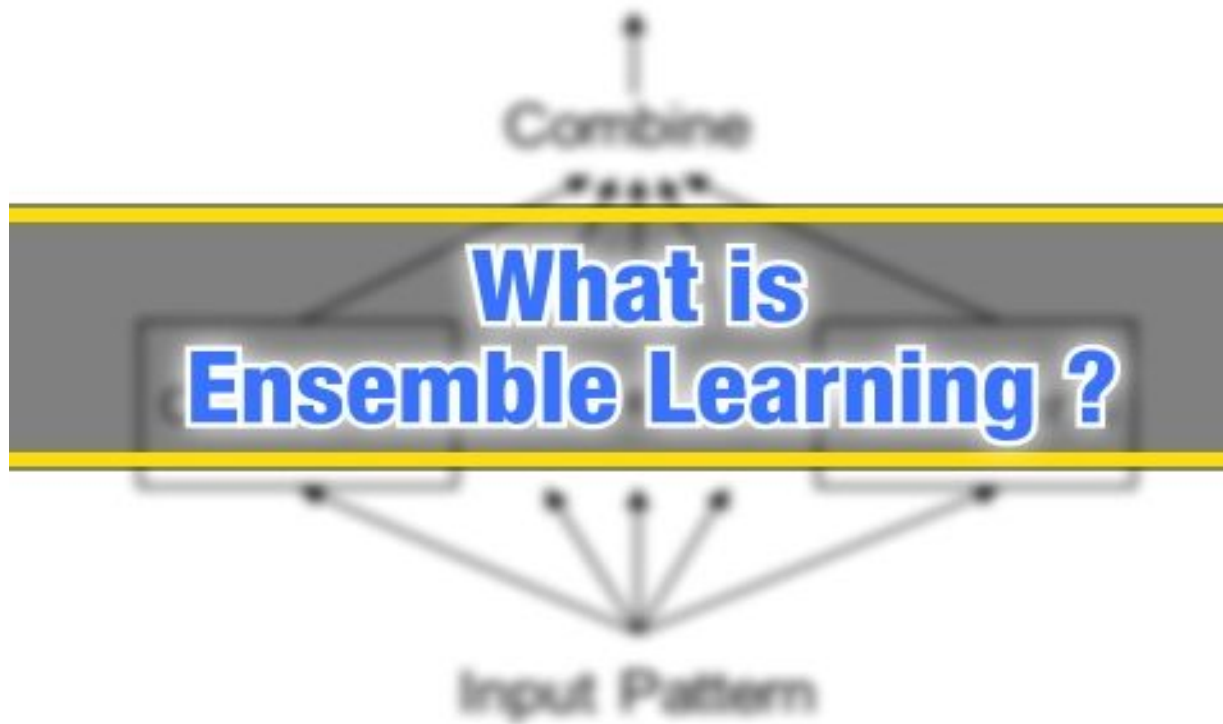




Ensemble Learning Techniques



Agenda

- Ensemble Learning
- Boosting
- Gradient Boosting and XGBoost
- Overfitting/Underfitting
- How to address Overfitting/Underfitting

**What is
Ensemble Learning ?**

Ensemble Learning



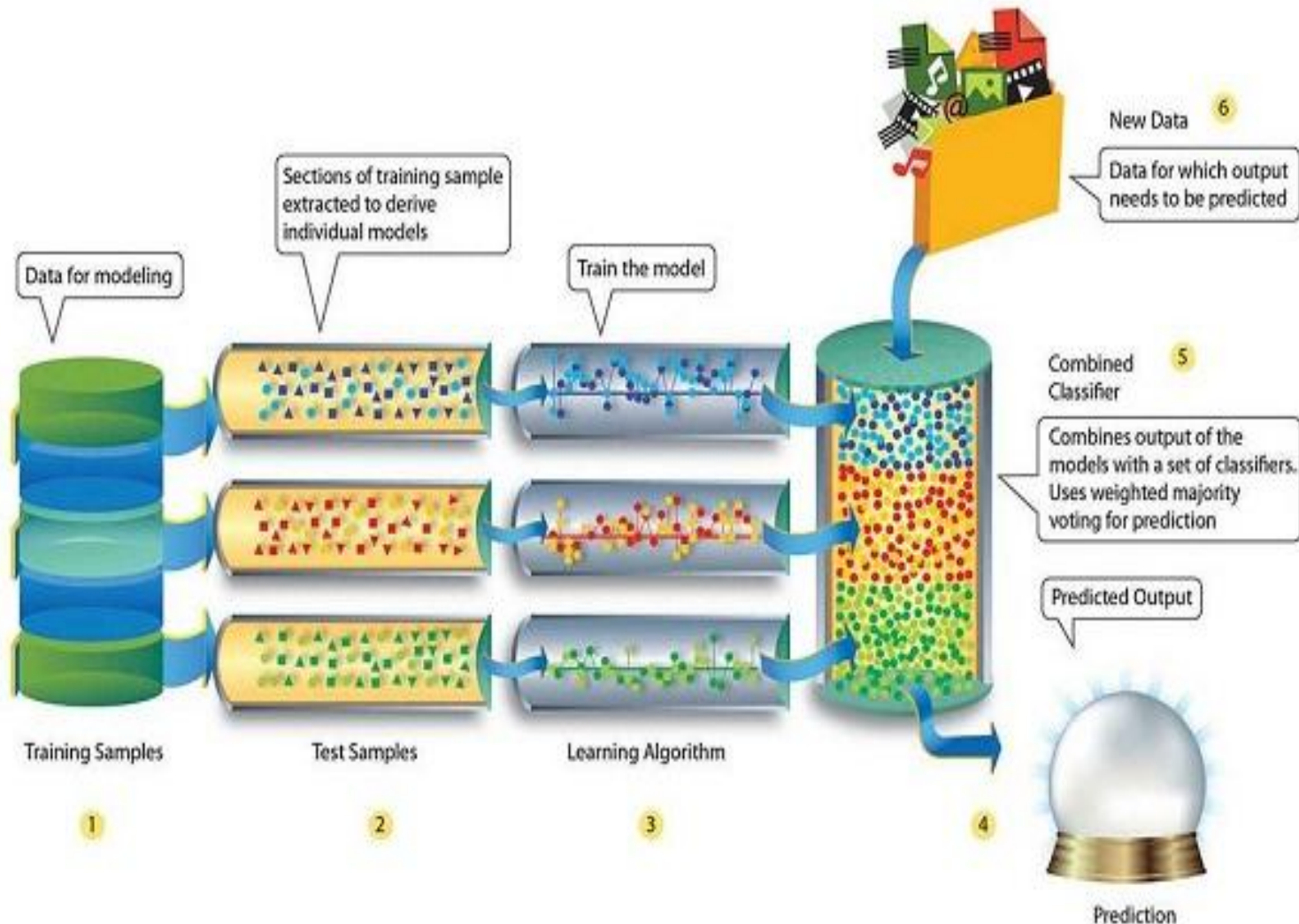
INTERNSHIPSTUDIO

- **Ensemble methods** is a machine learning technique that combines several base models in order to produce one optimal predictive model.
- The process of generating models from data is called learning or training and the learned model can be called as hypothesis or learner.
- This type of machine learning algorithm helps in improving the overall performance of the model.
- The learning algorithms which construct a set of classifiers are known as Ensemble methods.

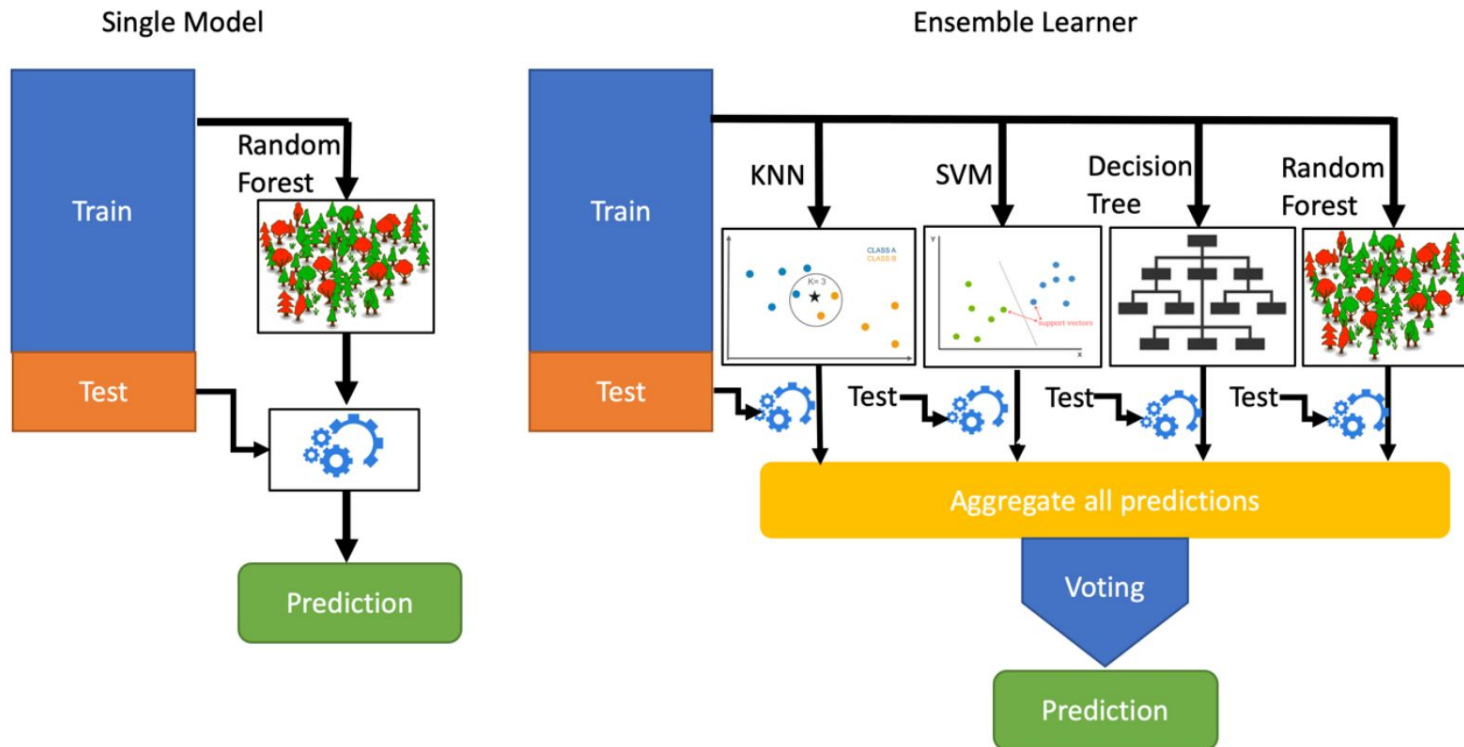
Ensemble Learning



INTERNSHIPSTUDIO

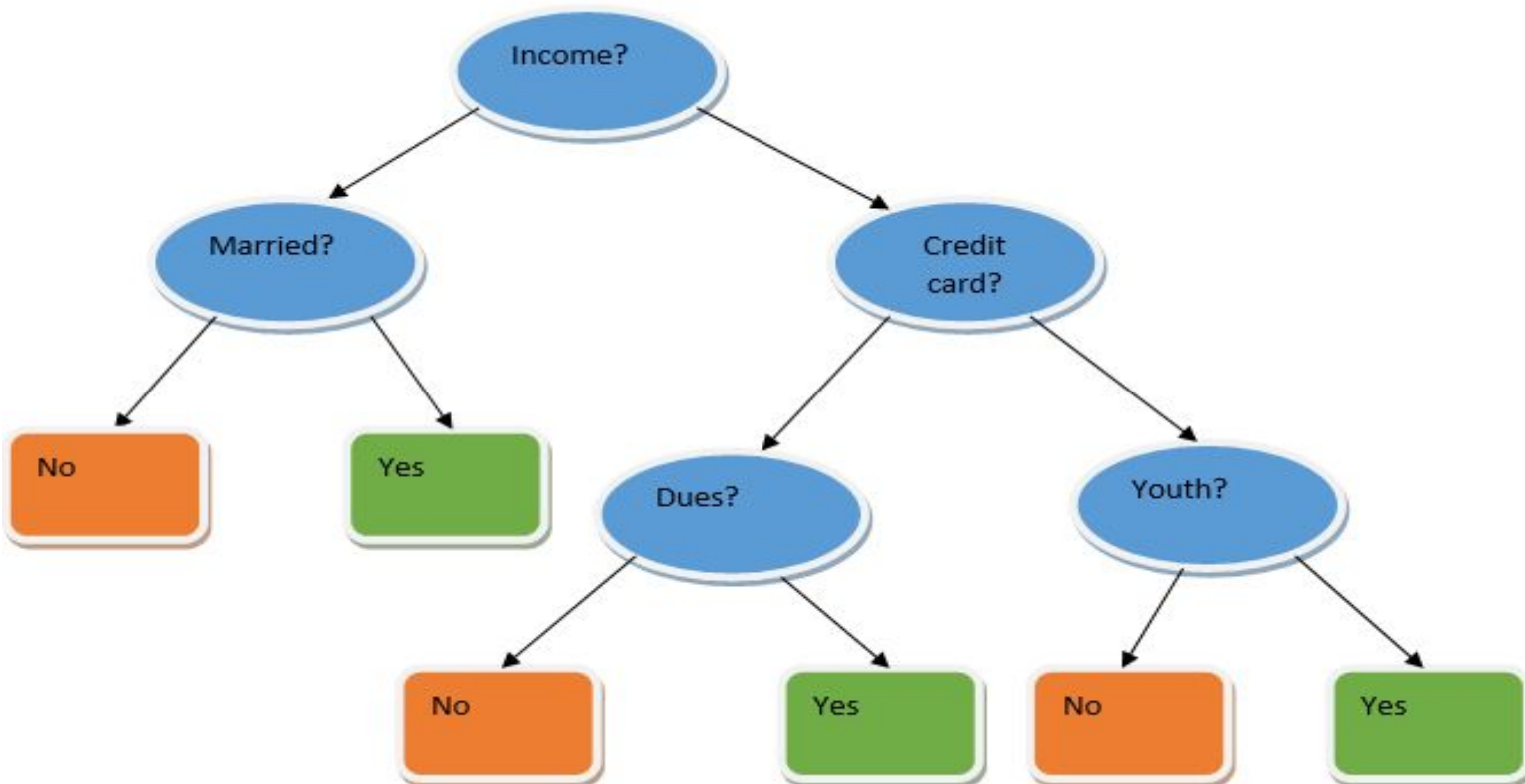


Single Model Prediction vs Ensemble Learner



Why Ensemble Methods?

- A diverse set of models in comparison to single models are likely to make better decisions.
- A decision tree basically works on several rules and provides a predictive output, where the rules are the nodes and their decisions will be their children and the leaf nodes will constitute the ultimate decision. The example of a decision tree below about a bank loan decision.

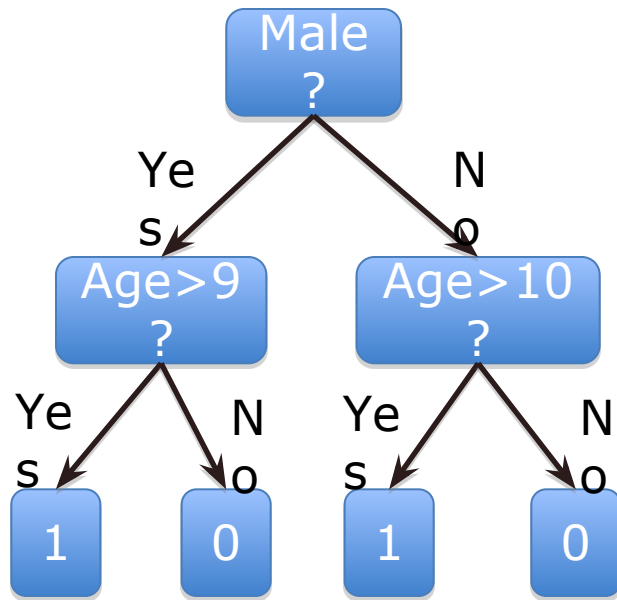


One classifier is not enough!

- Performance
 - None of the classifiers is perfect
 - Complementary
 - Examples which are not correctly classified by one classifier may be correctly classified by the other classifiers
- Potential Improvements
 - Utilize the complementary property

**What is
Ensemble Learning ?**

An EXAMPLE



Name	Age	Male?	Height > 55"
Alice	14	0	1
Bob	10	1	1
Carol	13	0	1
Dave	8	1	0
Erin	11	0	0
Frank	9	1	1
Gena	8	0	0



$$x = \begin{bmatrix} \text{age} \\ 1_{[\text{gender}=\text{male}]} \end{bmatrix}$$

$$y = \begin{cases} 1 & \text{height} > 55'' \\ 0 & \text{height} \leq 55'' \end{cases}$$



INTERNSHIPSTUDIO

Ensembles of Classifiers

Combine the classifiers to improve the performance

Ensembles of Classifiers


















































- Two ways to combine the classification results from different classifiers to produce the final output
 - Unweighted voting
 - Weighted voting

**What is
Ensemble Learning ?**

Example: Weather Forecast



INTERNSHIPSTUDIO

Reality							
1							
2							
3							
4							
5							
Combine							

Type of Ensemble methods:

The three most popular methods for combining the predictions from different models are:

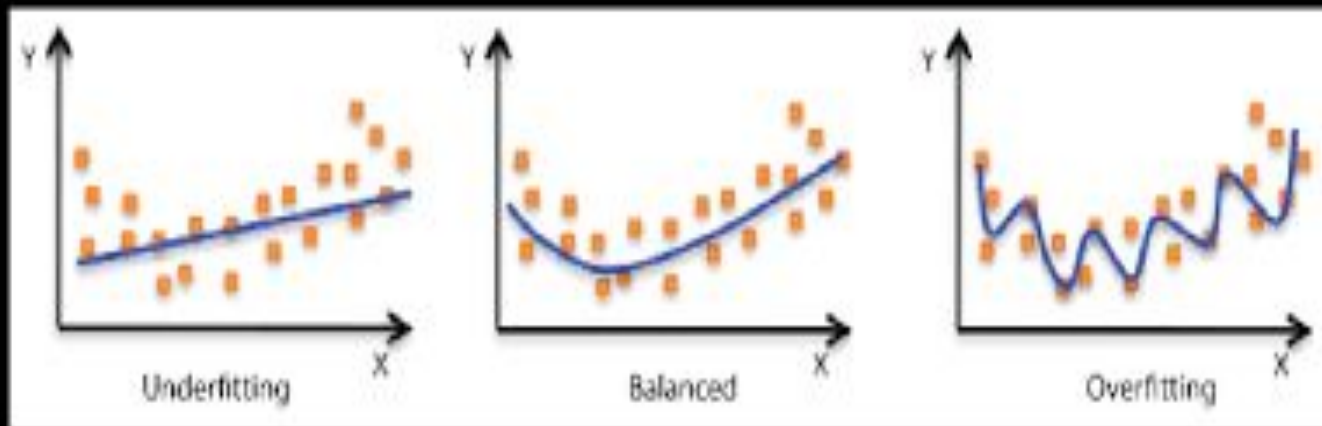
- **Bagging** Building multiple models (typically of the same type) from different subsamples of the training dataset.
- **Boosting**. Building multiple models (typically of the same type) each of which learns to fix the prediction errors of a prior model in the chain.
- Building multiple models (typically of differing types) and simple statistics (like calculating the mean) are used to combine predictions.

Bias and Variance



INTERNSHIPSTUDIO

- Bias is an error that occurs due to incorrect assumptions in our algorithm; a high bias indicates our model is too simple/underfit.
- Variance is the error that is caused due to sensitivity of the model to very small fluctuations in the data set; a high variance indicates our model is highly complex/overfit.
- An ideal ML model should have a proper balance between bias and variance.



Ensemble methods

- Ensemble methods that minimize variance
 - Bagging
 - Random Forests
- Ensemble methods that minimize bias
 - Functional Gradient Descent
 - Boosting
 - Ensemble Selection



- Q.1 What is Ensemble Learning?
- Q.2 What is the need of ensemble learning in ml?
- Q.3 Why only one classifier is not enough in Machine Learning?
- Q.4 What are the types of Ensemble Methods?