

classifier so our result will be 0 in this case.

- In case of Regression, the output will be average of the outputs of base learners.

• Important Point:

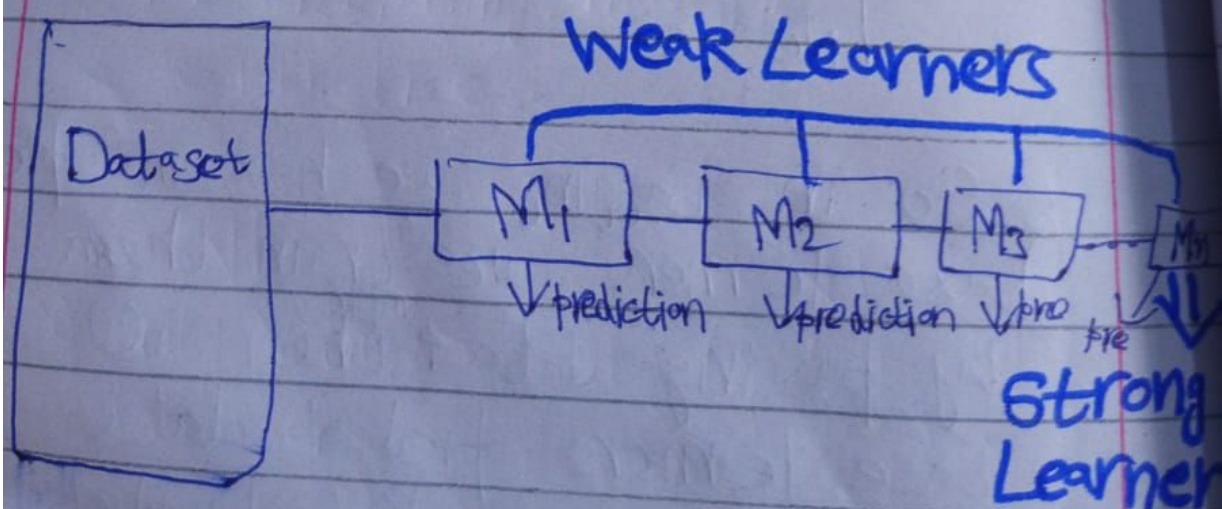
- In bagging all the base learners get trained parallelly.

e.g Algorithms: Random Forest

⇒ Boosting:

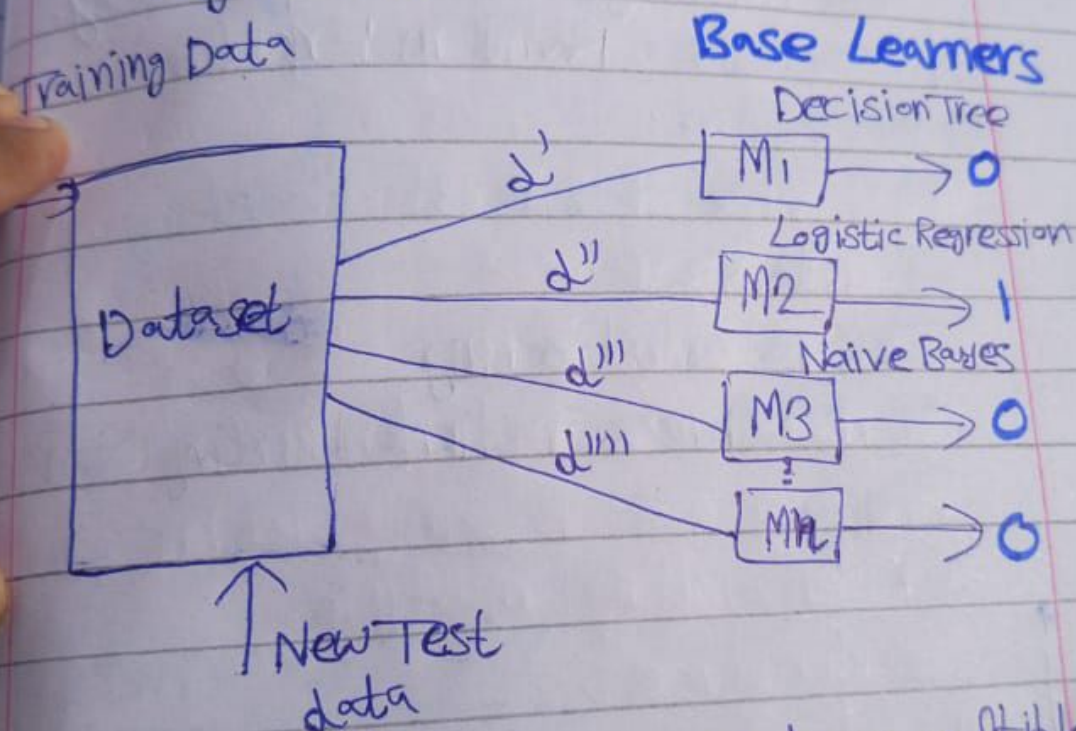
ML Algorithms of Boosting:

- ① Ada Boost
- ② Gradient Boosting
- ③ Extreme Gradient Boosting (XGBoost)



- ⇒ Random Forest.
- ⇒ Ensemble Techniques
 - Bagging and Boosting.
- Bagging:

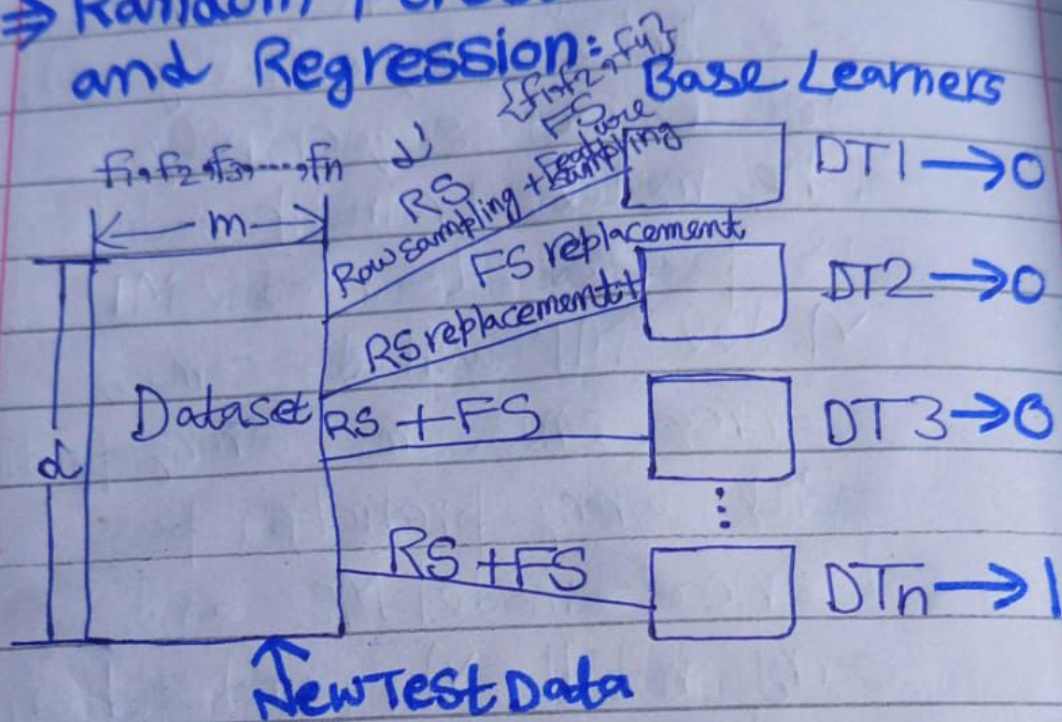
Idea behind bagging is that we have base learners (multiple models) can be of same or different ML algorithms.



- So in Bagging we have multiple base learners we train them by passing data ^{samples} then all base learners predict data which we need to predict and in case of classification we take **Majority voting**

- In Boosting, Weak Learners are linked sequentially and get trained sequentially.
- The models train like data is passed to model M_1 . Model M_1 will do some correct and some wrong predictions. The wrong prediction pass to next model M_2 and carry on till M_n and then we finally get a strong Learner.
- In Boosting also all the models give their prediction. In case of classification we use Majority Voting Classifier and in Regression we take average of outputs.

⇒ Random Forest Classification and Regression:

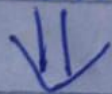


$d \Rightarrow$ Size of dataset

$m \Rightarrow$ No. of features

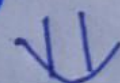
- In Random Forest, base learners are Decision Trees. And we use Bagging Technique for ensembling multiple decision trees.

Classification



Majority Voting Classifier

Regression



Average output of models

• Important interview question:

Q: Why should we use Random forest instead of Decision tree?

Decision Tree

overfitting

Train Accuracy \uparrow \rightarrow Low Bias

Test Accuracy \downarrow \rightarrow High Variance

- But with the help of Random Forest we reduce overfitting and achieve Generalize Model (Low Bias, Low variance)

Because our test accuracy increases and it decrease variance.