

Decision stump: A simple hyperplane that is always parallel to one of the axis.

Decision tree: A collection of decision stumps organized in a tree structure

Random forest: A collection (ensemble) of decision trees - the majority vote on bootstrapped samples to be precise

Boosting: Also a collection of decision trees but combined differently from majority vote

Majority vote of  $k$  classifiers can be written as the average output of  $k$  classifiers. Suppose the ensemble has  $k$  classifiers each with output of  $d_k$  which is  $+1$  or  $-1$ .

Majority-vote(ensemble) =  $\text{sign}(\text{average}(d_i))$

For example suppose we have 10 classifiers and 7 of them give  $+1$  and 3 give  $-1$ . Then the sign of the average value  $4/10 = 0.4$  which has positive sign. Therefore the majority vote is  $+1$ .

We can also write the majority vote as

Majority-vote(ensemble) =  $\text{sign}(\sum_i c_i d_i)$

where  $c_i = 1/k$

In boosting we have  $c_i$  proportional to the error of the  $i$ th classifier and we sample datapoints according to their error from the previous classifier.