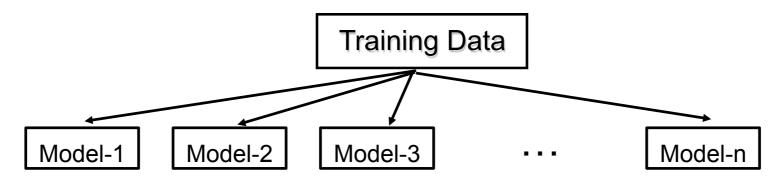
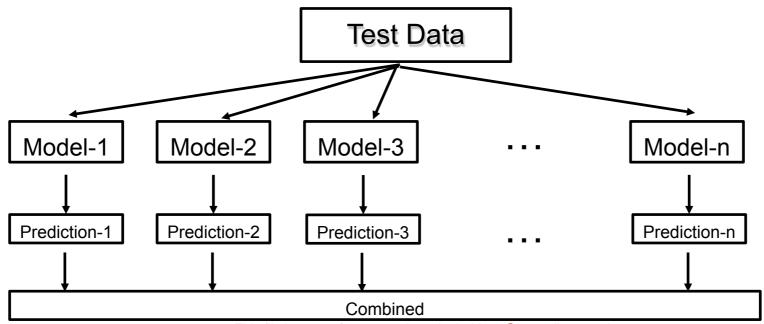


Ensemble Methods

- Ensembles are machine learning methods for combining predictions from multiple separate models.
- The central motivation is rooted under the belief that a committee of experts working together can perform better than a single expert.





Prediction

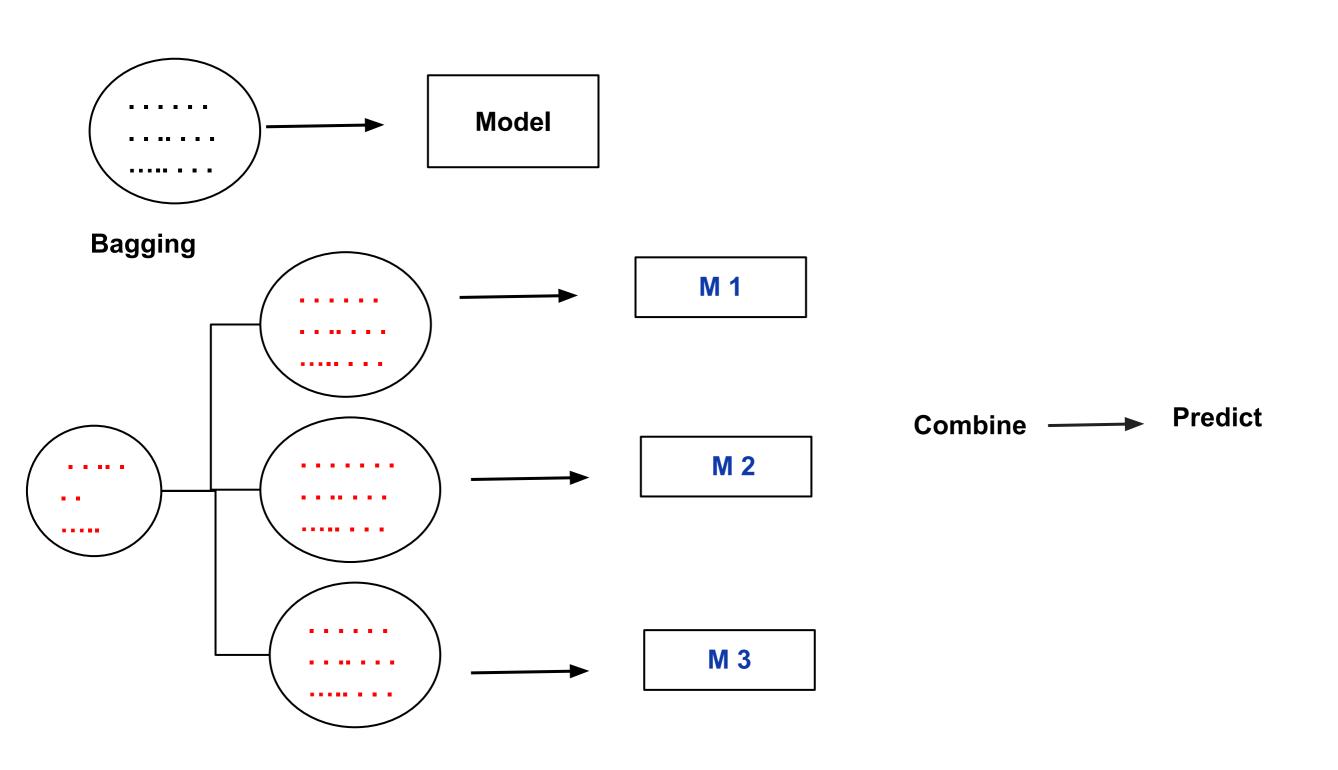


Ensemble Methods

	90%	90%	90%	90)%	90%	
Truth	M1	M2	M3			M10	
Υ					X		
Υ	X	X	X	X	X	X	
N				X	X	X	
		X		X	X		
Υ							
N							

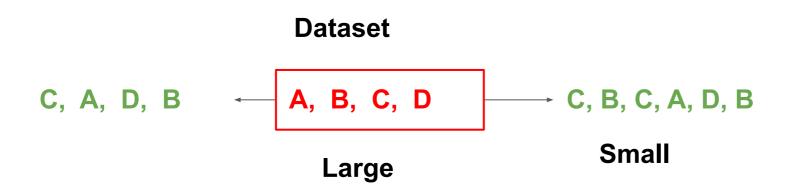


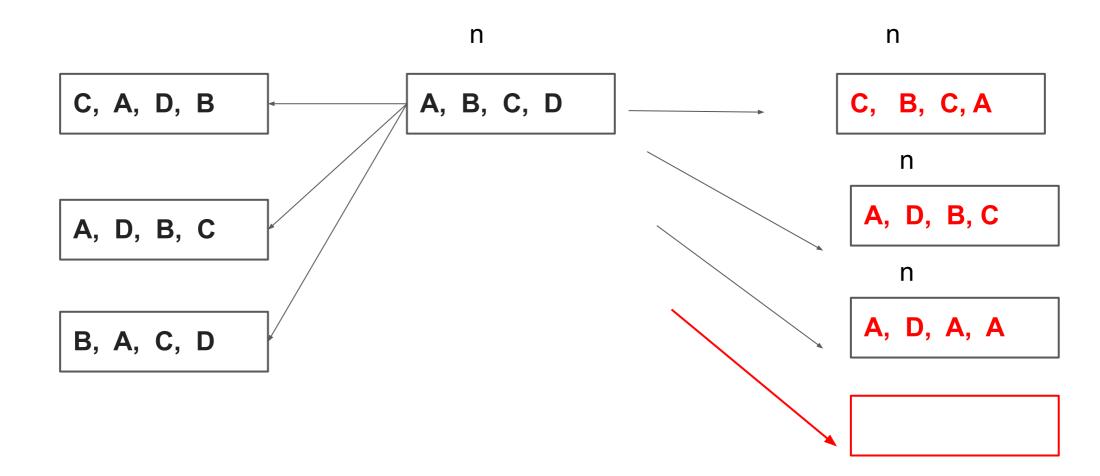




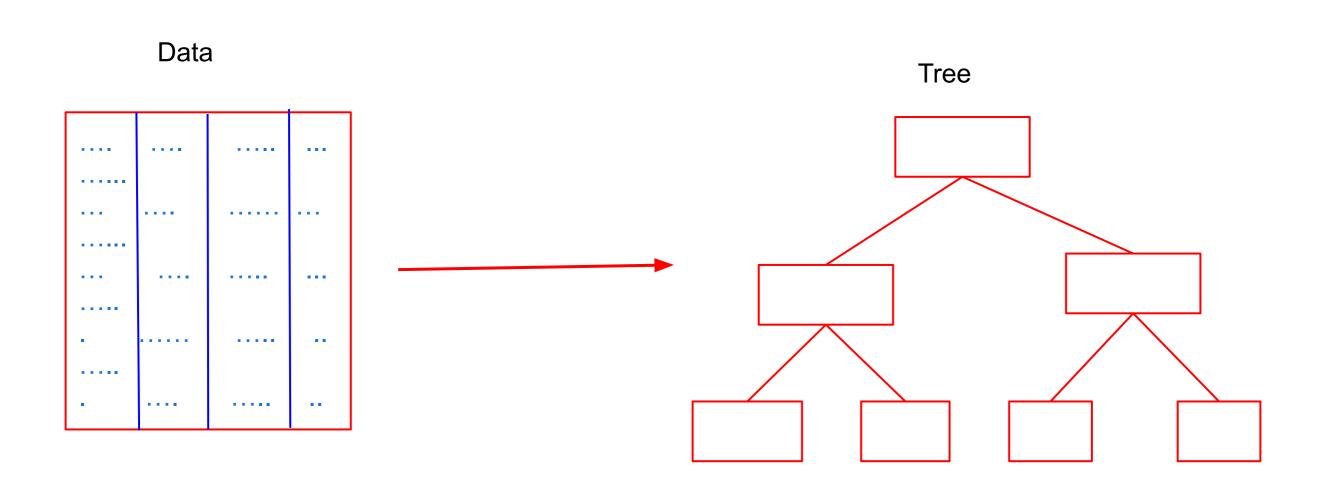


Why Sampling with Replacement?







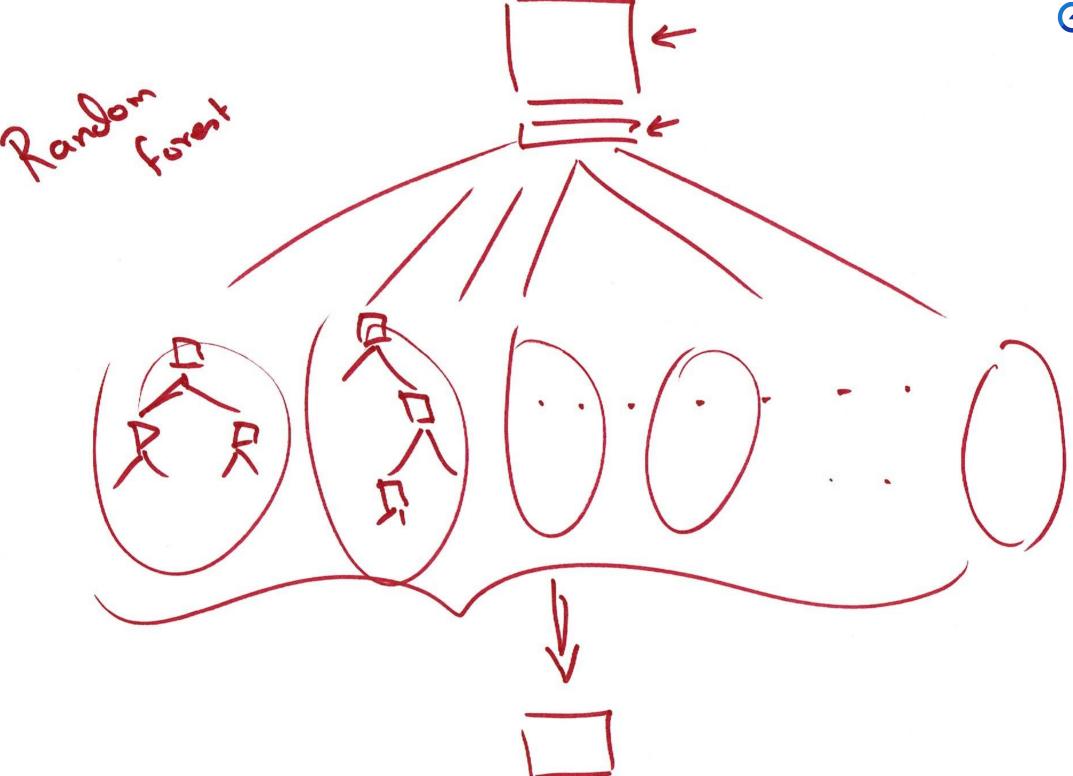


nrohibited



Tree to a Forest

- Decision trees are very sensitive to even small changes in the data usually called unstable.
- Can we get a whole bunch of decision trees to work together to yield a better and more robust prediction?
- Then for prediction we could use the mean for regression trees and mode for classification trees
- While individual trees are tend to over-fit training data, averaging corrects this.

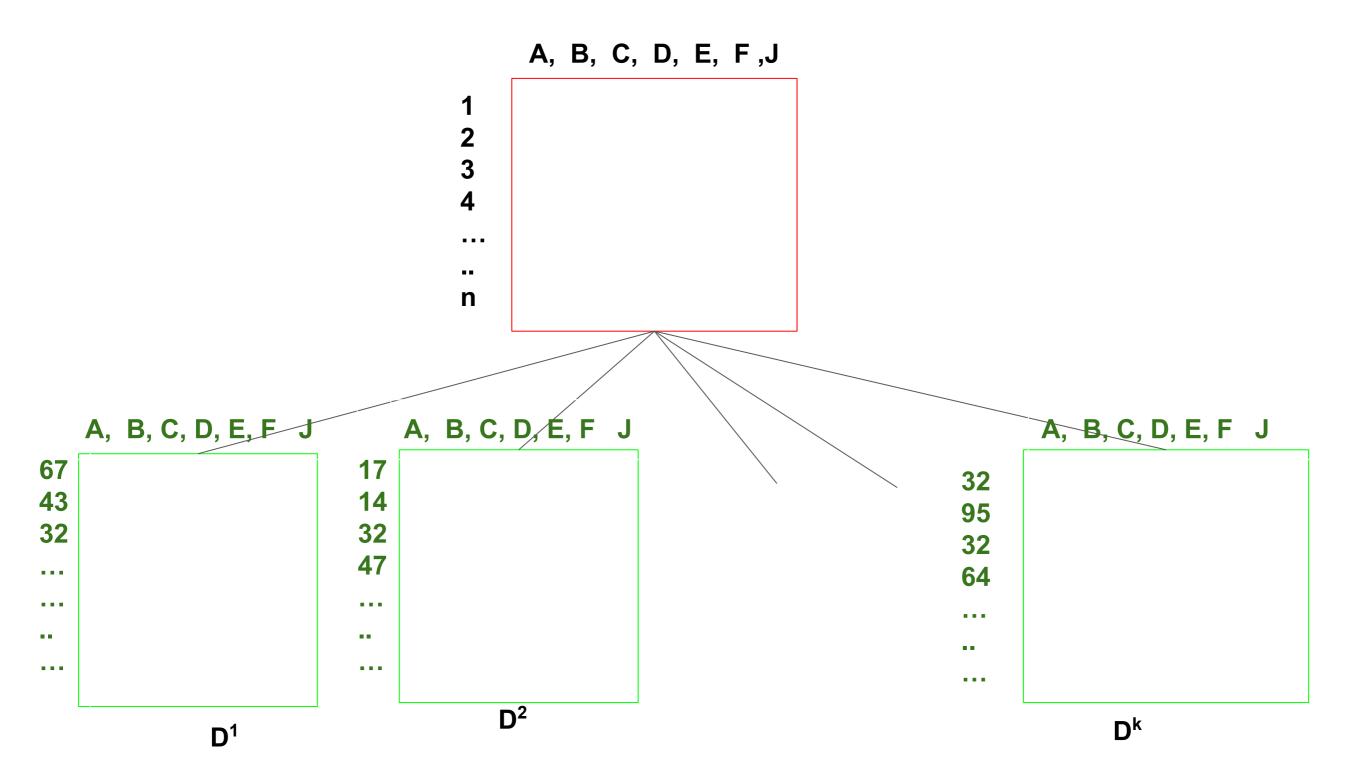




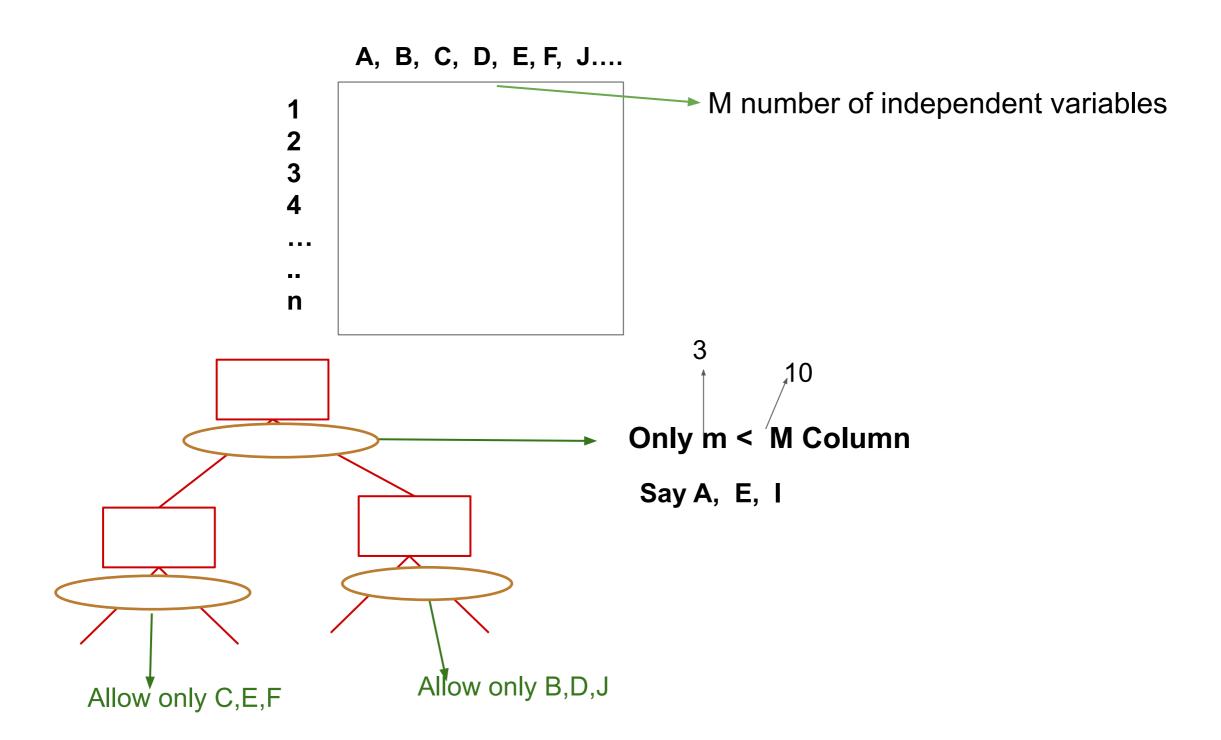
The General Ideas

- The general procedure of using multiple models (trees, in this case) to obtain better predictive performance is called ensemble learning.
- Bootstrap aggregating. also called bagging:
 - Generate new training subsets of the original, each of the same size (usually the size of the data) by sampling with replacement.
 - By sampling with replacement, some observations may be repeated in each subset.











Random forests

- Random Sampling with replacement
- For each subset build a decision tree. However, only use m randomly pick independent variables for each node's branching possibilities.
 - Do not prune
- While predicting:
 - Use each tree to make individual predictions
 - Combine predictions using voting:
 - Means for regression
 - Modes for classification



