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Q.) Explain ensemble methods for classification, where in you discuss bagging, random forest, boosting, Adaboost, Gradient Boost and XG Boost
Bagging 10 Marks
Boosting 10 Marks.

Bagging (Bootstrap Aggregating):

Bagging is a powerful ensemble technique used to reduce variance and prevent of overfitting in machine learning models. It works by creating multiple subsets of the original training data through random sampling with replacement, known as bootstrap samples. Each subset is then used to train a seperate base model, typically of the same type, such as decision trees.

The key idea behind bagging is to train diverse models that capture different aspects of the data & complexity. By aggregating the predictions of these models, either through averaging, averaging or majority voting, bagging tends to produce more robust and accurate predictions than any individual base model.

One of the most well-known algorithms that utilizes bagging is the random Forest algorithm. Random Forest builds multiple decision trees independently and combines their predictions through averaging or voting to make the final prediction. Each decision tree in the Random Forest is trained on a different

bootstrap a sample of the data, and features are randomly sampled at each split to further promote diversity among the trees.

Boosting →

Boosting is another ensemble technique aimed at improving model performance, particularly by reducing bias. Unlike bagging which focuses on reducing variance, boosting sequentially builds a strong learner by combining multiple weak learners.

Boosting algorithms start with a weak base model and iteratively improve it by giving more weight to the instances that were misclassified or poorly predicted by the previous models. This allows subsequent models to focus on the hard to predict instances, gradually reducing the overall error of the ensemble.

One of the earliest and most popular boosting algorithms is AdaBoost. Adaboost assigns weights to each training instance and adjusts these weights iteratively to emphasize the misclassified instances. It combines the predictions of multiple weak classifiers, such as decision trees with limited depth, to create a strong classifier.