Illustrate the concept of ensemble learning in machine learning?

Ensemble learning is a combination of several machine learning models in one problem. These models are known as weak learners. The intuition is that when you combine several weak learners, they can become strong learners.

Detailing the principles behind ensemble methods?

Basic ensemble learning techniques

- Max voting - max voting, the final prediction comes from the prediction with the most votes.
- Averaging - In averaging, the final output is an average of all predictions.
- Weighted average - In weighted averaging, the base model with higher predictive power is more important.

Advanced ensemble learning techniques

- Stacking - Stacking is the process of combining various estimators in order to reduce their biases.
- Blending - Blending is similar to stacking, but uses a holdout set from the training set to make predictions. So, predictions are done on the holdout set only. The predictions and holdout set are used to build a final model that makes predictions on the test set.
- Bagging - Bagging takes random samples of data, builds learning algorithms, and uses the mean to find bagging probabilities. It's also called bootstrap aggregating. Bagging aggregates the results from several models in order to obtain a generalized result.
- Boosting - Boosting is a machine learning ensemble technique that reduces bias and variance by converting weak learners into strong learners. The weak learners are applied to the dataset in a sequential manner. The first step is building an initial model and fitting it into the training set.

Applications of ensemble methods?

1. Disease detection

Classification and localization of diseases for simplistic and fast prognosis have been aided by Ensemble learning, like in cardiovascular disease detection from X-Ray and CT scans.

2. Remote Sensing

Monitoring of physical characteristics of a target area without coming in physical contact, called Remote Sensing, is a difficult task since the data acquired by different sensors have varying resolutions leading to incoherence in data distribution.

3. Fraud Detection

Detection of digital fraud is an important and challenging task since very minute precision is required to automate the process. Ensemble Learning has proved its efficacy in detecting Credit Card Fraud and Impression Fraud.

4. Speech emotion recognition

Ensemble Learning is also applied in speech emotion recognition, especially in the case of multi-lingual environments. The technique allows for the combining of all classifiers' effect instead of choosing one classifier and compromising certain language corpus's accuracy.