Naive Bayes

Definition - Naive Bayes is a family of simple but powerful classification algorithms based on applying Bayes' Theorem with the "naive" assumption of conditional independence between every pair of features, given the class label. Despite the unrealistic independence assumption, Naive Bayes works surprisingly well for many complex tasks.

How It Works

1 - **Bayes' Theorem**: Provides a way to calculate the probability of a class label given certain features. Mathematically it is expressed as:

$$P(C|X) = P(X|C)*P(C)/P(X)$$

- P(C|X) is the probability that the instance belongs to class C given the feature vector X
- P(X|C) is the probability of observing the feature vector X given class C
- P(C) is the probability that class C occurs overall in the dataset
- P(X) is the evidence or total probability of observing X, which is a normalizing constant

2 - **Naive Independence Assumption**: The naive part of the model assumes that the features (or attributes) are conditionally independent of each other, given the class label. This means that the presence (or absence) of a feature does not affect the presence of another feature, given the class label.

3 - **Classification Process**: For each class, the model computes the posterior probability (P(C|X) in the example) using Bayes' Theorem. The class that has the highest posterior probability is assigned as the predicted class for the new instance.