Naive Bayes Classifier

Naive Bayes Classifier Algorithm

- Naive Bayes algorithm is a supervised learning algorithm, which is based on Bayes theorem and used for solving classification problems.
- It is mainly used in **text classification** that includes a high-dimensional training dataset.
- Naive Bayes Classifier is one of the simple and most effective Classification algorithms which helps in building the fast machine learning models that can make quick predictions.
- It is a **probabilistic classifier**, which means it predicts on the basis of the **probability** of an object.
- Some popular examples of Naive Bayes Algorithm are spam filtration, Sentimental analysis, and classifying articles.

Why is it called Naive Bayes?

The Naïve Bayes algorithm is comprised of two words Naïve and Bayes,

Which can be described as:

1. **Naive**: It is called Naïve because it assumes that the occurrence of a certain feature is independent of the occurrence of other features. Such as if the fruit is identified on the bases of color, shape, and taste, then red, spherical, and sweet fruit is recognized as an apple. Hence each feature individually contributes to identify that it is an apple without depending on each other.
2. **Bayes**: It is called Bayes because it depends on the principle of Bayes' Theorem.

Bayes' Theorem

Bayes' theorem is also known as **Bayes' Rule or Bayes' law**, which is used to determine the probability of a hypothesis with prior knowledge. It depends on the conditional probability.

The formula for Bayes' theorem is given as:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Where,

P(A|B) is **Posterior** probability: Probability of hypothesis A on the observed event B.

P(B|A) is **Likelihood** probability: Probability of the evidence given that the probability of a hypothesis is true.

P(A) is **Prior** Probability: Probability of hypothesis before observing the evidence.

P(B) is **Marginal** Probability: Probability of Evidence.

Working of Naive Bayes' Classifier

Weather	Play
Sunny	No
Overcast	Yes
Rainy	Yes
Sunny	Yes
Sunny	Yes
Overcast	Yes
Rainy	No
Rainy	No
Sunny	Yes
Rainy	Yes
Sunny	No
Overcast	Yes
Overcast	Yes
Rainy	No

Frequency Table		
Weather	No	Yes
Overcast		4
Rainy	3	2
Sunny	2	3
Grand Total	5	9

Likelihood table				
Weather	No	Yes		
Overcast		4	=4/14	0.29
Rainy	3	2	=5/14	0.36
Sunny	2	3	=5/14	0.36
All	5	9		
	=5/14	=9/14		
	0.36	0.64		

Working of Nave Bayes' Classifier

Problem: Players will play if the weather is sunny. Is this statement correct?

P(Yes | Sunny) = P(Sunny | Yes) * P(Yes) / P (Sunny)

Here P(Sunny | Yes) * P(Yes) is in the numerator, and
P (Sunny) is in the denominator.

Here we have P (Sunny |Yes) = 3/9 = 0.33,
P(Sunny) = 5/14 = 0.36,
P(Yes)= 9/14 = 0.64

Now, P (Yes | Sunny) = 0.33 * 0.64 / 0.36 = **0.60**, which has higher probability.