

Naive Bayes

→ It is a supervised machine learning algorithm which is used to solve classification problem by using Baye's theorem.

Note: It is called Naive because it assumes that all of the independent features are independent of each other.

* Independent Events :

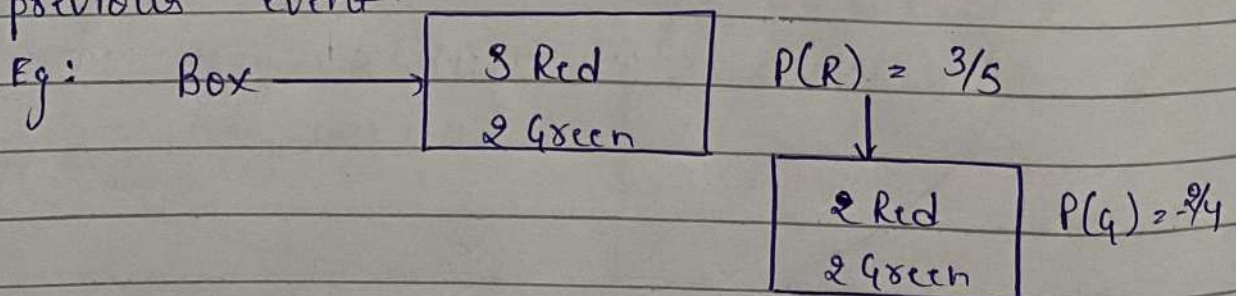
Those events whose occurrence is not dependent on any other event.

Eg: → Rolling a die $\in \{1, 2, 3, 4, 5, 6\}$
 $P(1) = \frac{1}{6}$, $P(2) = \frac{1}{6}$, $P(6) = \frac{1}{6}$

→ Tossing a coin $\in \{H, T\}$
 $P(H) = \frac{1}{2}$, $P(T) = \frac{1}{2}$

* Dependent Events :

Those events whose occurrence is dependent on previous event.



$$\therefore P(R \text{ and } G) = P(R) * P(G|R)$$

↳ conditional probability

* Baye's Theorem :

It determines the probability of an event based on prior knowledge of other related events which have already happened.

$$P(A \text{ and } B) = P(B \text{ and } A)$$

$$\Rightarrow P(A) * P(B|A) = P(B) * P(A|B)$$

$$\Rightarrow \boxed{P(B|A) = \frac{P(B) * P(A|B)}{P(A)}} \rightarrow \text{Baye's Theorem}$$

Dependent Event
Independent Event

→ Generalized Form for ML :

$$P(Y|x_1, x_2, \dots, x_n) = \frac{P(Y) * P(x_1|Y) * P(x_2|Y) \dots P(x_n|Y)}{P(x_1) * P(x_2) \dots P(x_n)}$$

$$P(N|x_1, x_2, \dots, x_n) = \frac{P(N) * P(x_1|N) * P(x_2|N) \dots P(x_n|N)}{P(x_1) * P(x_2) * \dots P(x_n)}$$

Note: As we can see the determinant is constant or never changing, therefore we can ignore it.

$$P(Y|x_1, x_2, \dots, x_n) \propto P(Y) * P(x_1|Y) * P(x_2|Y) * \dots P(x_n|Y)$$

→ How theorem predict target variable!

	outlook				→ Independent Feature
	Yes	No	P(y)	P(n)	
Sunny	2	3	2/9	3/5	
overcast	4	0	4/9	0	
Rain	3	2	3/9	2/5	
	9	5			

	Temperature				→ Independent Feature
	Yes	No	P(y)	P(n)	
Hot	2	2	2/9	2/5	
Mild	4	2	4/9	2/5	
cold	3	1	3/9	1/5	
	9	5			

	Play	
Yes	9	P(y) = 9/14
No	5	P(n) = 5/14
	14	

- Predicting probability (Yes/No) for Sunny & Hot.

$$\begin{aligned}
 P(y | \text{Sunny, Hot}) &= P(y) * P(\text{Sunny} | y) * P(\text{Hot} | y) \\
 &= \frac{9}{14} * \frac{2}{9} * \frac{2}{9} \\
 &= \frac{2}{63} = 0.031
 \end{aligned}$$

$$\begin{aligned}
 P(N | \text{Sunny, Hot}) &= P(N) * P(\text{Sunny} | N) * P(\text{Hot} | N) \\
 &= \frac{5}{147} \times \frac{3}{8} \times \frac{2}{5} \\
 &= \frac{3}{35} = 0.085
 \end{aligned}$$

$$\therefore P(Y | \text{Sunny, Hot}) = \frac{0.031}{0.031 + 0.085} = 0.267 = 26.7\%$$

$$\begin{aligned}
 P(N | \text{Sunny, Hot}) &= \frac{0.085}{0.031 + 0.085} = 0.732 = 73.2\%
 \end{aligned}$$