Naive Bayes Algorithm

this algo is only for classification problem

To understand naive bayes we need to understand
- Probability
- Bayes theorem

Probability → it is how likely something is to happen

$$P = \frac{\text{no. of favourable outcome}}{\text{Total no. of outcome}}$$

Independent Event → Two events are independent if the outcome of one event doesnot affect the outcome of other event. $P(x) = \frac{1}{2}$

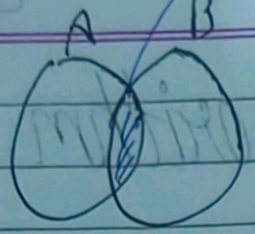
Dependent event → Two event are independent if outcome of on event affects the outcome of other event.

$P\left(\frac{x}{y}\right)$ = prob of x given y is already occured

$P(x \text{ and } y)$ = combine both step (1,2) / event
$= P(y) \times P\left(\frac{x}{y}\right)$

$\underbrace{P(a \text{ and } b) = P(a) \times P\left(\frac{b}{a}\right)}$ → Conditional prob.

$P(A) \times P\left(\frac{B}{A}\right)$



when A has already occured, then share of B will be overlapping part

$$p = \frac{fav(outcom)}{total\ outcome} = \frac{p(A\ and\ B)}{p(A)} \rightarrow P\left(\frac{B}{A}\right)$$

$$p(A\ and\ B) = P(A) \times P\left(\frac{B}{A}\right)$$

proved Conditional probability

Bayes theorem

$$P(A\ and\ B) = P(B\ and\ A)$$

$$P\left(\frac{B}{A}\right) \times P(A) = P(B) \times P\left(\frac{A}{B}\right)$$

$$\boxed{P\left(\frac{A}{B}\right) = \frac{P\left(\frac{B}{A}\right) \times P(A)}{P(B)}}$$

Bayes theorem

$$\rightarrow P(A/B) = \frac{P(B/A) \times P(A)}{P(B)}$$

$$P(y/x_1x_2x_3) = \frac{P(y) \times P\left(\frac{x_1x_2x_3}{y}\right)}{P(x_1x_2x_3)}$$

x_1	x_2	x_3	y
–	–	–	1
–	–	–	0
–	–	–	0
–	–	–	1

$$P\left(y / x_1, x_2, x_3\right) = \frac{P(y) \times P\left(\frac{x_1}{y}\right) \times P\left(\frac{x_2}{y}\right) \times P\left(\frac{x_3}{y}\right)}{\underbrace{P(x_1) \times P(x_2) \times P(x_3)}_{\text{Constant}}}$$

1 / 0

P(yes) p(No)

$P(0.60, 0.40) \longrightarrow$ p(y) being class 1 is higher then final ans is class 1

$$P\left(\frac{yes}{x_1 x_2 x_3}\right) = \frac{P(yes) \times P\left(\frac{x_1}{yes}\right) \times P\left(\frac{x_2}{yes}\right) \times P\left(\frac{x_3}{yes}\right)}{\underbrace{P(x_1) \times P(x_2) \times P(x_3)}_{\text{constant}}}$$

Predicted class = $\max\left(P\left(y/x_1 x_2 x_3\right), P\left(\frac{N}{x_1 x_2 x_3}\right)\right)$

Note = For multiple classes also formulae remain same

- explanation on a data set

Day	Outlook	Temperature	Humidity	Wind	Play golf
1	Sunny	Hot	High	W	N
2	Sunny	Hot	High	S	N
3	Overcast	Hot	High	W	Y
4	rain	mild	High	W	Y
5	Rain	cool	Normal	W	Y
6	Rain	Cool	Normal	S	N
7	Overcast	Cool	Normal	S	Y
8	sunny	mild	High	W	N
9	Sunny	cool	Normal	W	Y
10	rain	mild	Normal	W	Y
11	Sunny	mild	Normal	S	Y
12	overcast	mild	High	S	Y
13	overcast	Hot	Normal	W	Y
14	Rain	mild	High	S	N

$$P(y/x_1,x_2,x_3) = \frac{P(y) \times P\left(\frac{x_1}{y}\right) \times P\left(\frac{x_2}{y}\right) \times P\left(\frac{x_3}{y}\right)}{P(x_1) \times P(x_2) \times P(x_3)}$$

Constant

	y	N
~~Outlook~~		
~~Overcast~~		
~~Temperature~~		
R		

Outlook

		y	N	P(E/y)	P(N/y)
5/14	Sunny	2	3	2/9	3/5
4/14	Overcast	4	0	4/9	0/5 = 0
5/14	Rain	3	2	3/9	2/5
	total	9	5		

Similarly → Temp

	y	N	P(E/y)	P(E/N)	$P(x_i)$
Hot	2	2	2/9	2/5	4/14
mild	4	2	4/9	2/5	6/14
Cold	3	1	3/9	1/5	4/14
	9	5			

Humidity

	y	N	P(E/y)	P(E/N)	
High	3	4	3/9	4/5	7/14
Normal	6	1	6/9	1/5	7/14
	9	5			

Wind

	y	N	P(E/y)	P(E/N)	
Week	6	2	6/9	2/5	8/14
Strong	3	3	3/9	3/5	6/14
	9	5			

$P(y) = 9/14$

$P(N) = 5/14$