Naive Baye's Algorithm (only for classification problem)

① Probability
② Baye's theorem.

* **Probability** :- Probability is how likely something is to happen.

$$P = \frac{\text{No of favourable outcomes}}{\text{Total no of outcomes}}$$

$$P(H) = \frac{1}{2}$$

$$P(T) = 1/2$$

→ **Independent Events** → Two events are independent if the outcome of one event doesnot affect the outcome of other event.

3 yellow balls
2 green balls

$$P(Y) = \frac{3}{3+2} = \frac{3}{5}$$

$$\Rightarrow P(G) = \frac{2}{2+3} = 2/5$$

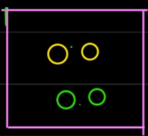
* After picking the ball for first time, you are returning the ball to the bag and due to this the probabilities remained the same for second selection.

* **Dependent Events**

Two events are dependent if the outcome of one event affects the outcome of the other event.

What is the probability of picking a yellow ball and then a green ball?

- Step-1 P of picking a yellow ball $\Rightarrow P(Y) = \frac{3}{5}$ → Event 1
- Step-2 P of picking green ball when yellow ball has been already picked $\Rightarrow P(G/Y) = \frac{2}{4}$ → Event 2



$P(G/Y) \Rightarrow$ Probability of Green given Yellow

$P(Y \text{ and } G)$ = Combine both the steps | events.

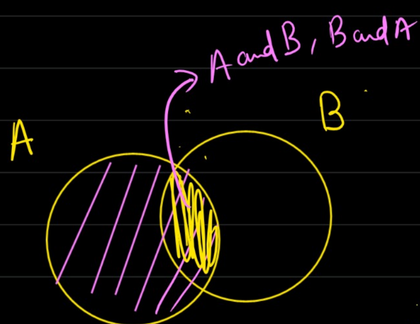
$= P(Y) * P(G/Y) = \frac{3}{5} \times \frac{2}{4} \Rightarrow \frac{3}{10}$

1st even ... 2nd event.

$$\boxed{P(A \text{ and } B) = P(A) \times P(B/A)}$$ → Conditional probability.

$P(B/A)$ = Probability of event B, given A event has already occured

$P(B/A)$

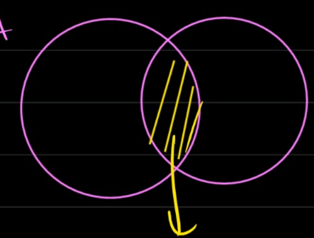


When A has already occured, the share of B will be the overlapping part.

$$P = \frac{\text{Fav outcome}}{\text{total comes}} = \frac{P(A \text{ and } B)}{P(A)} = P(B/A)$$

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

* Baye's theorem



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

$$P(B/A) \cdot P(A) = P(A/B) \cdot P(B)$$

A and B or

B and A

$A \cap B$ or

$B \cap A$

$$\boxed{P(A/B) = \frac{P(A) * P(B/A)}{P(A)}}$$

$\Rightarrow$ Baye's theorem.

$P(A|B) \Rightarrow$ Prob. of Event A given B has occurred

$P(A) \Rightarrow$ Prob of Event A

$P(B) \Rightarrow$ Prob of Event B

$P(B/A) \Rightarrow$ Prob of Event B given has occured.

$$\boxed{P(A/B) = \frac{P(A) * P(B/A)}{P(B)}}$$

x_1	x_2	x_3	y
—	—	—	1
—	—	—	0
—	—	—	1
—	—	—	0

feature

target

$$P(\overset{A}{y} / \overset{B}{(x_1, x_2, x_3)}) = \frac{P(y) * P(x_1, x_2, x_3 / y)}{P(x_1 x_2 x_3)}$$

$$\boxed{P(y/(x_1, x_2, x_3)) = \frac{P(y) * P(x_1/y) \cdot P(x_2/y) \cdot P(x_3/y)}{P(x_1) \cdot P(x_2) \cdot P(x_3)}}$$

x_1	x_2	x_3	y (1 - yes, 0 - NO)
—	—	—	1
—	—	—	0
—	—	—	1
			0
			1

$\rightarrow 1 \longrightarrow P(0.60, 0.40) \rightarrow$ class 1

$P(Y) \quad P(N)$

$y \rightarrow$ yes

$y \rightarrow$ NO

Y has only two possibility $\begin{cases} \text{Yes} \\ \text{No.} \end{cases}$

$$P(\text{yes}/(x_1, x_2, x_3)) = \frac{P(\text{yes}) * P(x_1/\text{yes}) * P(x_2/\text{yes}) * P(x_3/\text{yes})}{\cancel{P(x_1) * P(x_2) * P(x_3)}\ \text{Constant}} = 0.70$$

$$P(\text{NO}/(x_1, x_2, x_3)) = \frac{P(\text{No}) * P(x_1/\text{No}) * P(x_2/\text{No}) * P(x_3/\text{No})}{\cancel{P(x_1) * P(x_2) * P(x_3)}\ \text{Constant}} \Rightarrow 0.30$$

$P(x1) . P(x_2) P(x_3) \rightarrow$ Constant

Predicted class = max class of Prob.

$= (0.70, 0.30)$

$\downarrow$

1

* For multiclass classification

$$P(C_k/X) = \frac{P(X/C_k) * P(C_k)}{P(X)}$$

$$\begin{cases} P(C_1/x_1 x_2 x_3) = \dfrac{P(C_1) * P(x_1/C_1) * P(X_2/C_1) \times P(X_3/C_1)}{\cancel{P(x_1) \times P(x_2) * P(x_3)} \rightarrow \text{Const}} \\ P(C_2/x_1 x_2 x_3) = (\qquad) \\ P(C_3/x_1 x_2 x_3) \Rightarrow \dfrac{P(C_3) * P(x_1/C_3) * P(x_2/C_3) \times P(x_3/C_3)}{\text{Const.}} \end{cases}$$

$\downarrow$

Maximum probability will be predicted class.