$x = \{x_1, x_2, x_3, \ldots x_n\} \rightarrow$ column

$C_k = \{c_1, c_2, c_3 \ldots \ldots C_k\} \rightarrow$ class

From previous example,

toss	vanue	outlook	result
x_1	x_2	x_3	$c_1 =$ won
			$c_2 =$ loss

Our final task would be find,

$$P(C_k \mid x)$$

we know,

$$P(C_k \mid x) = P(x \mid C_k)\, P(C_k) \cdots \text{(i)}$$

according to conditional Probability:

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$\Rightarrow P(A|B)\,P(B) = P(A \cap B) \quad \cdots\cdots \text{(ii)}$$

From (i) and (ii)

$$P(C_k|X) = P(X \cap C_k)$$

we can replace $\cap \Rightarrow ,$

$$P(C_k|x) = P(x, C_k)$$

$$= P(\underbrace{x_1}_{a}, \underbrace{x_2, x_3 \cdots x_n | C_k}_{\cap\ b}) = P(a|b)\,P(b)$$

$$= P(x_1 | x_2, x_3 \cdots x_n, C_k)\,P(b)$$

$$\Rightarrow P(C_k|X) = \alpha \times P(x_2, x_3 \cdots x_n, C_k)$$

same as, $P(x_2, x_3 \cdots x_n, C_k) \times \alpha$

$$= \alpha \times P(x_2 | x_3 \cdots x_n, C_k)\,P(x_3 \cdots x_n, C_k)$$

$$= \alpha \times \beta \times P(x_3 \cdots x_n, C_k)$$

$$= P(x_1 | x_2 \cdots x_n, C_k)\,P(x_2 | x_3 \cdots x_n, C_k)$$

$p(x_3 | x_4 \cdots x_n, C_k) \cdots\cdots$

$p(x_n, C_k)\, p(C_k)$

Now, we will assume x_1 is not depend on $x_2, x_3 \cdots x_n$, it depends on only C_k. We make this assumption cause the event is rare, maximum times the event never exist. that's why we assume they are conditionally independent. and only depends on C_k.

Now we will simplify the entire equation and we have,

$$= p(x_1 | C_k)\, p(x_2 | C_k)\, p(x_3 | C_k) \cdots$$

$$p(C_k)$$

So, $P(C_k|x) \propto P(C_k) \prod_{i=1}^{n} P(x_i|C_k)$

$\propto$, cause we neglected the $P(x)$

So,

$$\hat{y} = \underset{k \in \{1,2,\cdots K\}}{\operatorname{argmax}} P(C_k) \prod_{i=1}^{n} P(x_i|C_k)$$

$\boxed{\text{Maximum a Posterior Rule.}}$