

⑥ Naive Bayes - Mushroom Classification Example



1



2



3

$$X = \begin{matrix} & x_1 & x_2 & x_3 \end{matrix} \\ \begin{bmatrix} - & - & - \\ - & - & - \\ - & - & - \end{bmatrix}$$

$$Y = \begin{matrix} y \end{matrix} \\ \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

Test Point = (x, y)

$$\textcircled{1} \quad 0.6 \Rightarrow P(Y=1 | x)$$

$$= \frac{P(x | Y=1) P(Y=1)}{P(x)}$$

$$= \frac{P(x | Y=1) P(Y=1)}{P(x | Y=1) P(Y=1) + P(x | Y=2) P(Y=2) + P(x | Y=3) P(Y=3)}$$

$P(x)$ = Marginal Probability of x

Common for all three

$$\textcircled{2} \quad 0.25 \Rightarrow P(Y=2 | x)$$

$$\textcircled{3} \quad 0.15 \Rightarrow P(Y=3 | x)$$

(x, y)

$x = \langle x_1, x_2, x_3 \rangle$

Features

↓
weight

size ↓

colour

Naive Assumption:

All features are independent of each other

$$p(x|y=1) = \prod p(x_1|y=1) p(x_2|y=1) p(x_3|y=1)$$

Final Formula

$$p(y=1|x) \propto \prod_{i=1}^n p(x_i|y=1) p(y=1)$$

$y \in C$

$$p(y=c|x) \propto \prod_{i=1}^n p(x_i|y=c) p(y=c)$$

Likelihood

Prior

Probability

$$= \prod_{i=1}^n p(x_i|y=c) p(y=c)$$

$$\sum_{c=1}^K \left(\prod_{i=1}^n p(x_i|y=c) p(y=c) \right)$$

Marginal Probability