

Quiz 4. Naïve Bayes

A1	A2	A3	Class
1	0	1	yes
1	0	1	yes
0	1	1	yes
0	0	1	no
1	0	0	no

Classify the following record $E = \{ A1=0, A2=1, A3=0 \}$ using Naïve Bayes classifier by comparing $P(\text{yes} | E)$ and $P(\text{no} | E)$.

Apply Laplace correction:

	A1=0	A1=1	A2=0	A2=1	A3=0	A3=1
Yes: 3+2	1+1	2+1	2+1	1+1	0+1	3+1
No: 2+2	1+1	1+1	2+1	0+1	1+1	1+1

$$\begin{aligned}
 P(\text{yes} | A1=0, A2=1, A3=0) &= P(A1=0 | \text{Yes}) * P(A2=1 | \text{Yes}) * P(A3=0 | \text{Yes}) * P(\text{Yes}) * \alpha = \\
 &= \frac{2}{5} * \frac{2}{5} * \frac{1}{5} * \frac{5}{9} * \alpha = 0.018 \alpha
 \end{aligned}$$

$$\begin{aligned}
 P(\text{No} | A1=0, A2=1, A3=0) &= P(A1=0 | \text{No}) * P(A2=1 | \text{No}) * P(A3=0 | \text{No}) * P(\text{No}) * \alpha = \\
 &= \frac{2}{4} * \frac{1}{4} * \frac{2}{4} * \frac{4}{9} * \alpha = 0.028 * \alpha
 \end{aligned}$$

The record is classified as No

To compute probabilities:

$$P(\text{Yes} | E) : P(\text{No} | E) = 0.018 / 0.028 = 0.64$$

$$0.64 P(\text{No} | E) + P(\text{No} | E) = 1$$

$$P(\text{No} | E) = 1 / 1.64 = 61\% \quad P(\text{Yes} | E) = 39\%$$