Naive Bayes Example.

training data ⇒

Text	Tag / label
"A great game"	Sports
"The election was over"	Not Sports
"Very clean match"	Sports
"A clean but forgettable game"	Sports
"It was close election"	Not Sports

test data to predict: "A very close game"

Probability

$P\left(\frac{\text{Sports}}{\text{a very close game}}\right)$ $P\left(\frac{\text{Not Sports}}{\text{a very close game}}\right)$

Bayes' Theorem

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

$$\equiv) \frac{P(\text{a very close game}/\text{sports}) \times (P(\text{sports}))}{P(\text{a very close game})}$$

We can discard the divisor - which is same for both tags - and just compare

$P\left(\frac{\text{a very close game}}{\text{sports}}\right) \times P(\text{Sports})$ With $P\left(\frac{\text{a very close game}}{\text{Not sports}}\right) \times P(\text{Not Sports})$

Now Naive - assuming every word is independent

P(a very close game) = P(a) × P(very) × P(close) × P(game)

or

$P\left(\frac{\text{a very close game}}{\text{sports}}\right) = P\left(\frac{a}{\text{sports}}\right) \times P\left(\frac{\text{very}}{\text{sports}}\right) \times P\left(\frac{\text{close}}{\text{sports}}\right) \times P\left(\frac{\text{game}}{\text{sports}}\right)$

probability of each tage

P(sports) = 3/5 P(Not sports) = 2/5

Laplace smoothing - adding 1 to every count so its never zero

calculations

Word	P(word/sports)	P(word/Not sports)
a	$\frac{2+1}{11+14}$	$\frac{1+1}{9+14}$
very	$\frac{1+1}{11+14}$	$\frac{0+1}{9+14}$
close	$\frac{0+1}{11+14}$	$\frac{1+1}{9+14}$
game	$\frac{2+1}{11+14}$	$\frac{0+1}{9+14}$
	$= 2.76 \times 10^{-5}$	$= 0.572 \times 10^{-5}$
	$= 0.0000276$	$= 0.00000572$

✓ winner