

Naive Bayes Example
created by André Rodrigues

Naïve Bayes Classifier

Simplest probabilistic model for **classification**:

$$P(X | Y = y) = \prod_{i=1}^d P(X_i | Y = y)$$

where X is a set of attributes and Y is the class.

Naïve Bayes Classifier

Naive Bayes assumes that attributes X are independent given the class variable Y .

Naïve Bayes Classifier

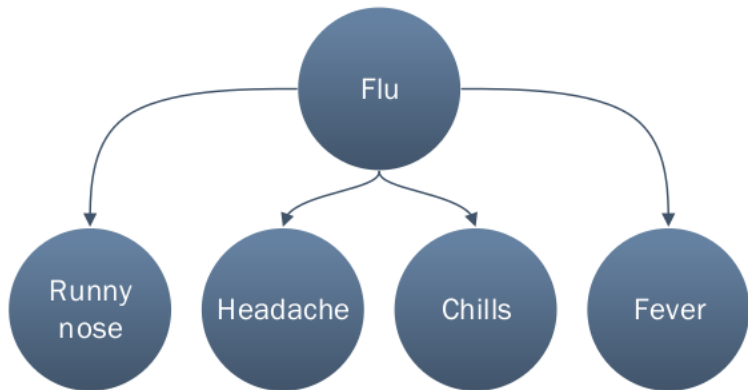
To classify a test example, the Naive Bayes classifier computes the posterior probability for each class Y :

$$P(Y | X) = P(Y) \prod_{i=1}^d P(X_i | Y = y)$$

Given a set of observations...

Runny nose	Headache	Chills	Fever	Flu
no	strong	true	false	no
no	strong	true	true	no
little	strong	true	false	yes
high	mild	true	false	yes
high	no	false	false	yes
high	no	false	true	no
little	no	false	true	yes
no	mild	true	false	no
no	no	false	false	yes
high	mild	false	false	yes
no	mild	false	true	yes
little	mild	true	true	yes
little	strong	false	false	yes
high	mild	true	true	no

...build the Naïve Bayes Classifier and...



...Conditional Probability Tables (CPTs or network parameters)

Flu			
yes	no	$P(\text{yes})$	$P(\text{no})$
9	5	$\frac{9}{14}$	$\frac{5}{14}$

...Conditional Probability Tables (CPTs or network parameters)

Runny nose				
	yes	no	$P(\text{yes})$	$P(\text{no})$
no	2	3	$\frac{2}{9}$	$\frac{3}{5}$
little	4	0	$\frac{4}{9}$	$\frac{0}{5}$
high	3	2	$\frac{3}{9}$	$\frac{2}{5}$
total	9	5	100%	100%

Headache				
	yes	no	$P(\text{yes})$	$P(\text{no})$
strong	2	2	$\frac{2}{9}$	$\frac{2}{5}$
mild	4	2	$\frac{4}{9}$	$\frac{2}{5}$
no	3	1	$\frac{3}{9}$	$\frac{1}{5}$
total	9	5	100%	100%

Chills				
	yes	no	$P(\text{yes})$	$P(\text{no})$
true	3	4	$\frac{3}{9}$	$\frac{4}{5}$
false	6	1	$\frac{6}{9}$	$\frac{1}{5}$
total	9	5	100%	100%

Fever				
	yes	no	$P(\text{yes})$	$P(\text{no})$
false	6	2	$\frac{6}{9}$	$\frac{2}{5}$
true	3	3	$\frac{3}{9}$	$\frac{3}{5}$
total	9	5	100%	100%

Now, use the model to predict classes

Given a new patient with symptoms: Runny nose=no,
Headache=no, Chills=true, Fever=true
Calculate:

$$P_{Yes} = P(Flu = Yes \mid RN = no, H = no, Chills = true, Fever = true)$$

$$P_{No} = P(Flu = No \mid RN = no, H = no, Chills = true, Fever = true)$$

If $P_{Yes} > P_{No}$, patient has Flu, otherwise, patient has no Flu.