



## Why

We often want to predict one of several outcomes.

## Definition

A *classifier* is a predictor whose codomain is a finite set. In this case, we call the codomain the *label set* and we call its elements *classes* (or *labels*, *categories*). We call the prediction of a classifier on an input a *classification*.

If the set of labels has two elements, then we call the classifier a *binary classifier* (or *two-way classifier*, *two-class classifier*, *boolean classifier*). In the case that there are  $k$  labels, we call the classifier a *k-way classifier* (or *k-class classifier*, *multi-class classifier*). The second term is meant to indicate, not that the classifier assigns to each point several classes, but that the classification decision is made *between* several classes.

## Basic examples

Let  $A$  be a set of inputs and let  $B$  be a set of labels. Define  $B = \{0, 1\}$  (or  $\{-1, 1\}$ , FALSE, TRUE, NEGATIVE, POSITIVE). Then  $B$  is finite with two elements and  $f : A \rightarrow B$  is a binary classifier with labels 0 and 1.

If the case  $B = \{\text{NO}, \text{MAYBE}, \text{YES}\}$ , we call  $f : A \rightarrow B$  a three-way classifier. Other examples for  $B$  include a list of languages, the set of English words in some dictionary, or the set of  $m!$  possible orders of  $m$  horses in a race.

When dealing with a finite set of  $k$  arbitrary objects, it is often convenient to take associate the objects with the first  $k$  positive integers and take the set  $B = \{1, \dots, k\}$  as the set of labels; here  $k \in \mathbf{N}$ .

## Other terminology

Following our terminology, but speaking of processes, some authors refer to the application of inductors for these special cases as *binary classifi-*

*cation* and *multi-class classification*. Or they speak of *classification* and *classification problems*. Roughly speaking, a classifier *classifies* all inputs into categories.

Alternatively, some authors (especially in the statistics literature) refer to a classifier as a *discriminator* and reference *discrimination problems*.

