

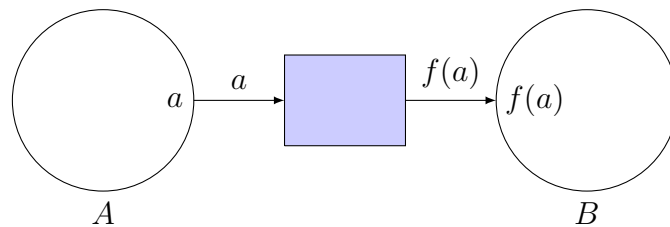
# Functions: Graphing in the Cartesian Plane

Video companion

## 1 Introduction

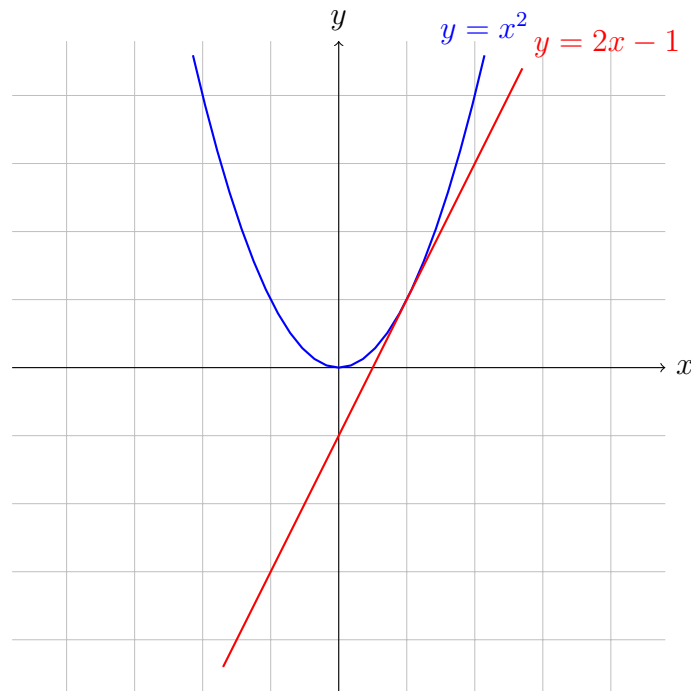
Last time: abstract depiction of a function as a machine

$$f : A \rightarrow B$$



This video: graphs of functions

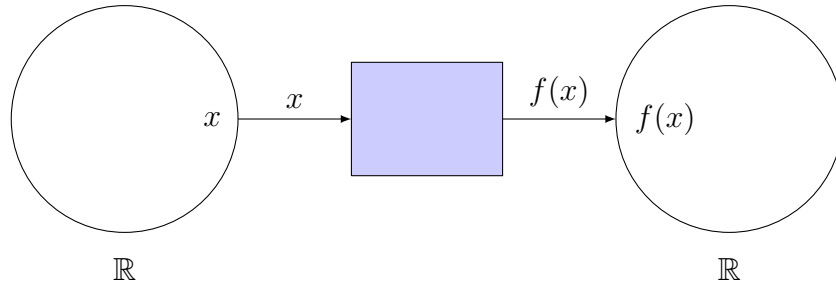
$$f : \mathbb{R} \rightarrow \mathbb{R}$$



You will learn the difference between a *graph* of a function and the function itself.

## 2 Map real line to real line

$$f : \mathbb{R} \rightarrow \mathbb{R}$$



A function is a formula, a rule for how to operate the machine.

$$\begin{aligned} f(x) &= 2x - 1 \\ f(1) &= 2(1) - 1 = 1 \\ f(0) &= 2(0) - 1 = -1 \\ f(5.1) &= 2(5.1) - 1 = 9.2 \end{aligned}$$

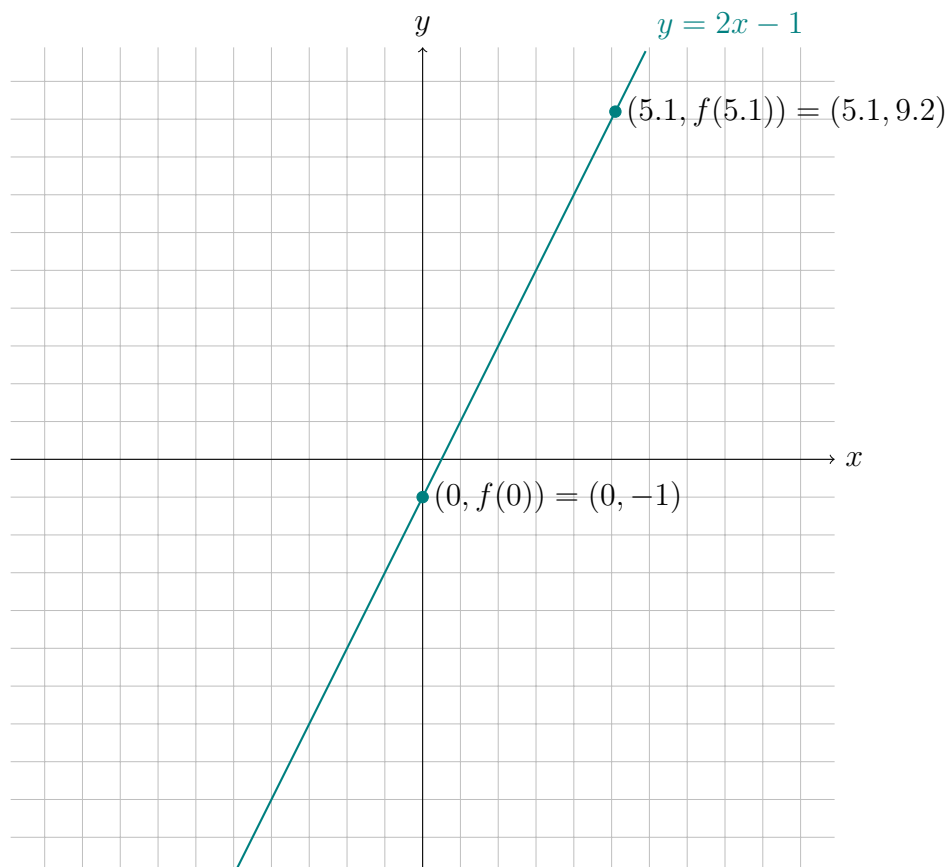
More complicated formulas, like absolute value:

$$\begin{aligned} g(x) &= |x| \\ &= \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases} \end{aligned}$$

Both  $f$  and  $g$  are functions, with a formula for how to compute the result.

### 3 What is a graph?

Graph of the function  $f : \mathbb{R} \rightarrow \mathbb{R}$

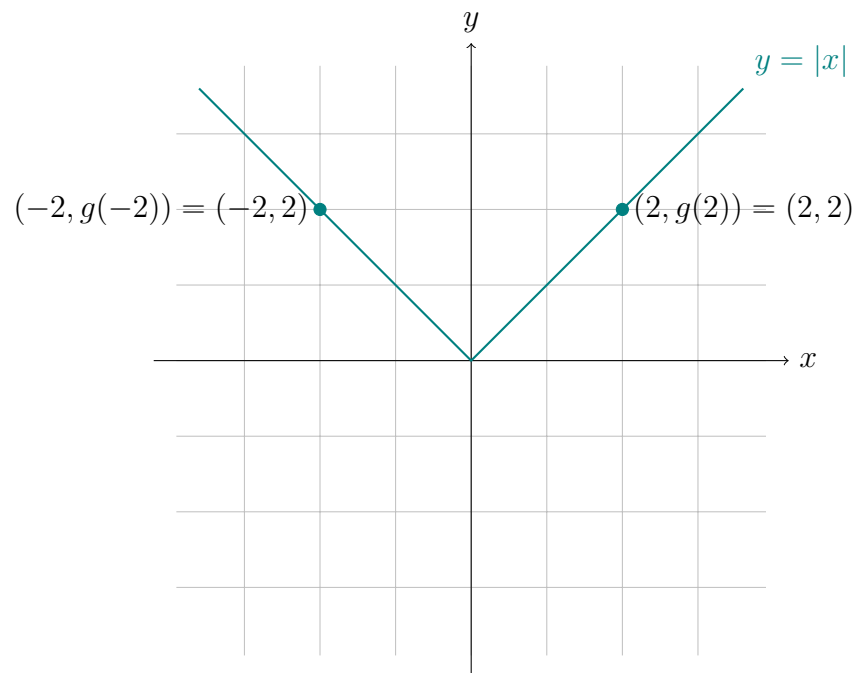


If  $g$  is a function  $: \mathbb{R} \rightarrow \mathbb{R}$ , the graph of  $g = \{(x, y) \in \mathbb{R}^2 : y = g(x)\}$

## 4 Examples

### Absolute value function

$$\begin{aligned} g(x) &= |x| \\ &= \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases} \end{aligned}$$



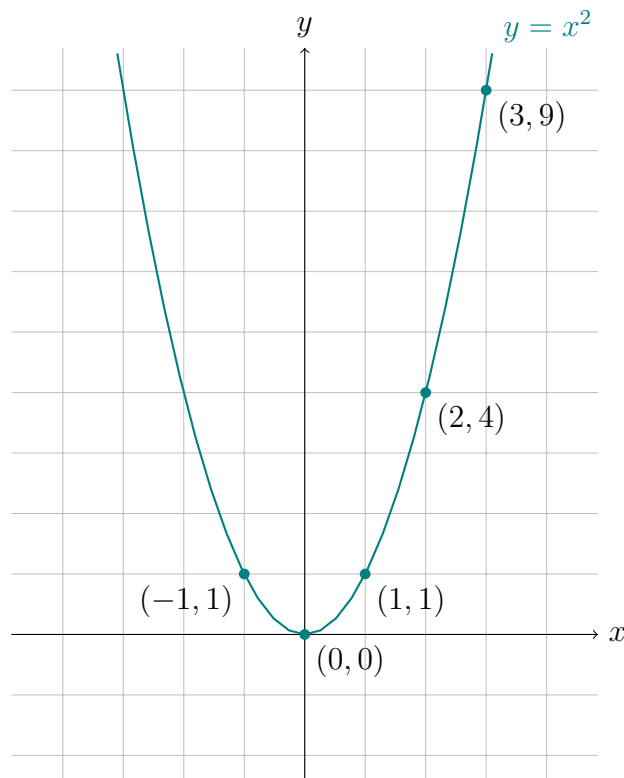
## Quadratic function

$$h(x) = x^2$$

Graph a function by testing input and output pairs, see a pattern, and try to draw a curve through it. This is similar to *querying* in supervised learning.

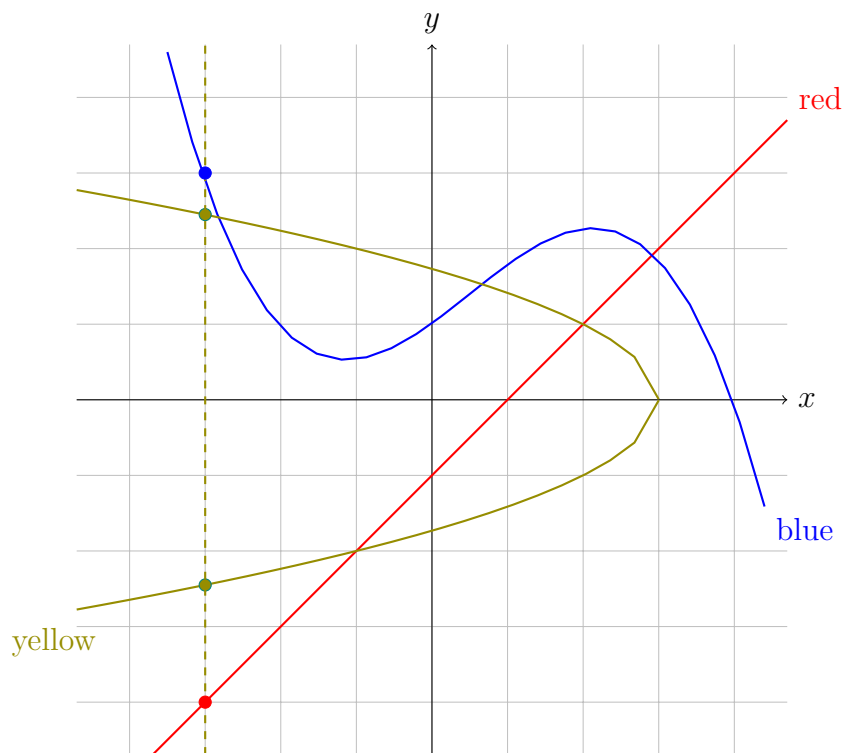
Table of values:

$x$	$h(x)$
0	$0^2 = 0$
1	$1^2 = 1$
2	$2^2 = 4$
3	$3^2 = 9$
-1	$(-1)^2 = 1$



$h(x) = x^2$  is a *quadratic* function.

## 5 Vertical line test



Red and blue could be graphs of functions. Yellow could not be the graph of a function because it violates the *vertical line test*, which states that *any vertical line intersects the graph of a function once*.