

$f(x)$

# Functions

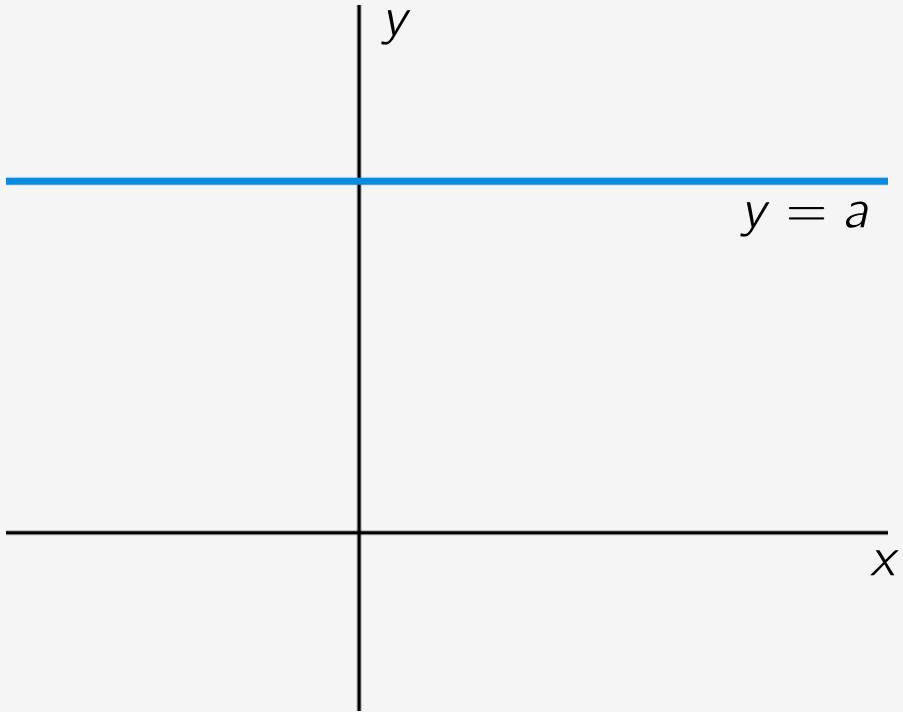
## Graphs of polynomial functions

Bart van den Dries



photo: Jorrit Lousberg

# Degree 0: constant functions



**Standard form:**

$$f(x) = a$$

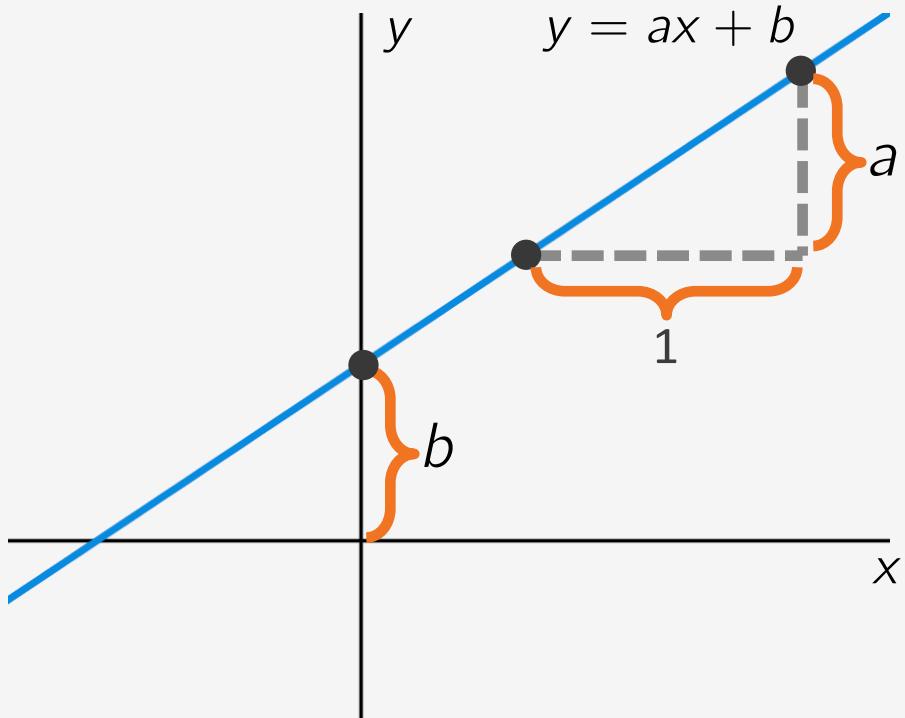


$$= 1$$

**Graph:**

horizontal line

# Degree 1: linear functions



**Standard form:**

$$f(x) = ax + b$$

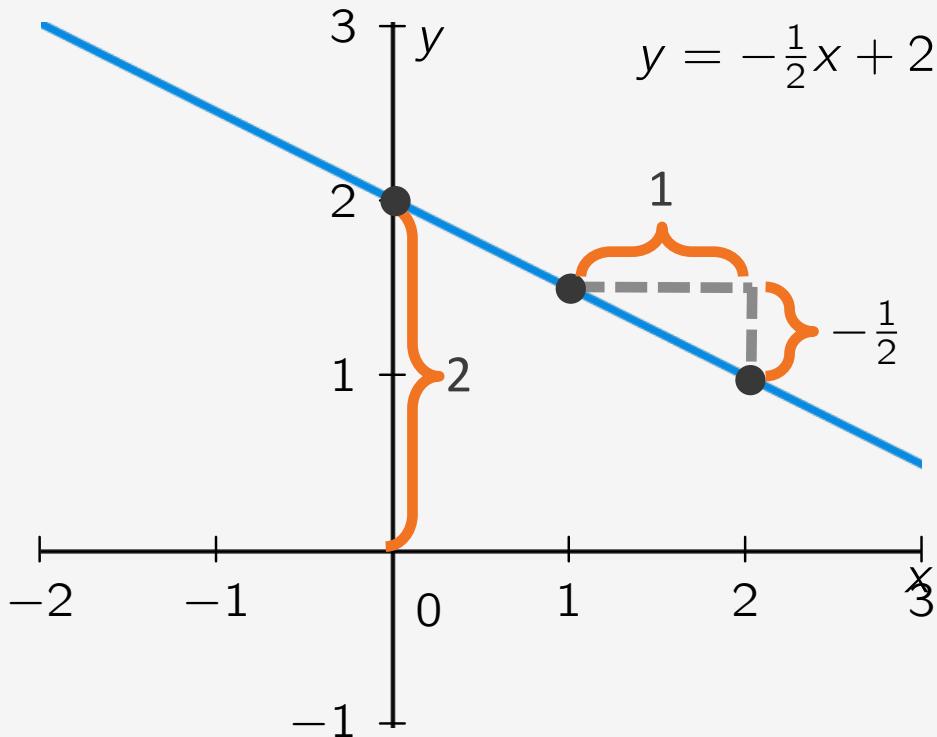
**Graph:**

straight line

$a$  = slope

$b$  =  $y$ -intercept

# Degree 1: example



**Example:**

$$f(x) = -\frac{1}{2}x + 2$$

**Graph:**

$$\text{slope} = -\frac{1}{2}$$

$$y-\text{intercept} = 2$$

# Degree 2: quadratic functions

Height:

$$h(t) = -4.9t^2 + 6.1t + 1.4$$

Trajectory:

$$h(x) = 3.3 - 0.4x^2$$



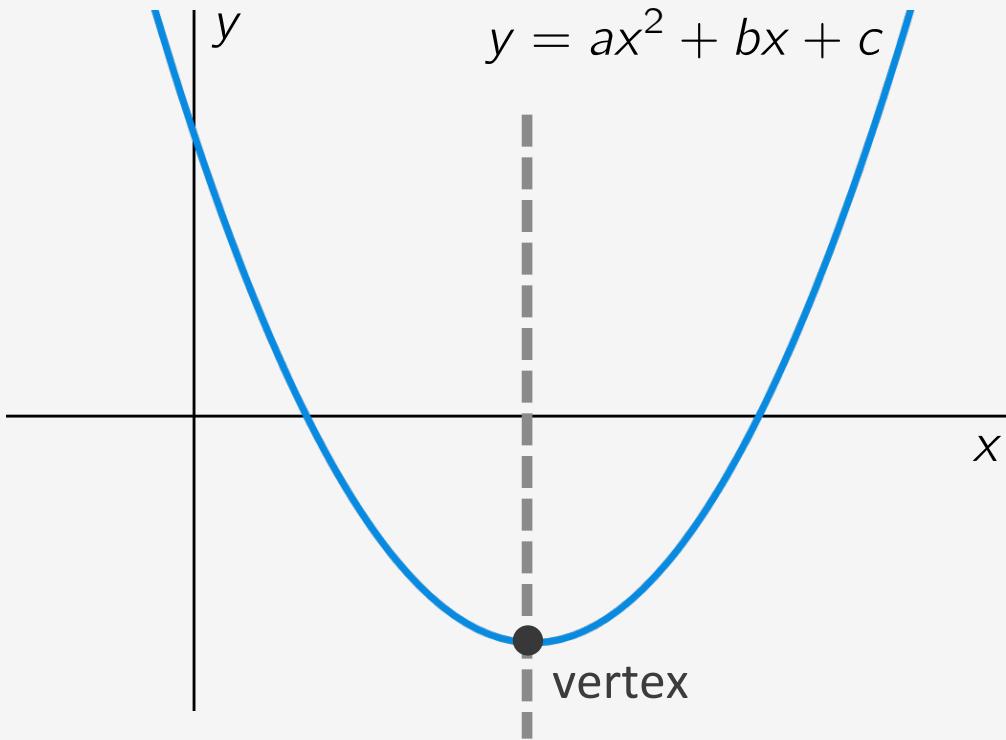
# Degree 2: quadratic functions



$$h(x) \approx 0.00037x^2 - 0.475x + 230$$

above sealevel in m  
 $x$  in m from left pillar

# Degree 2: quadratic functions

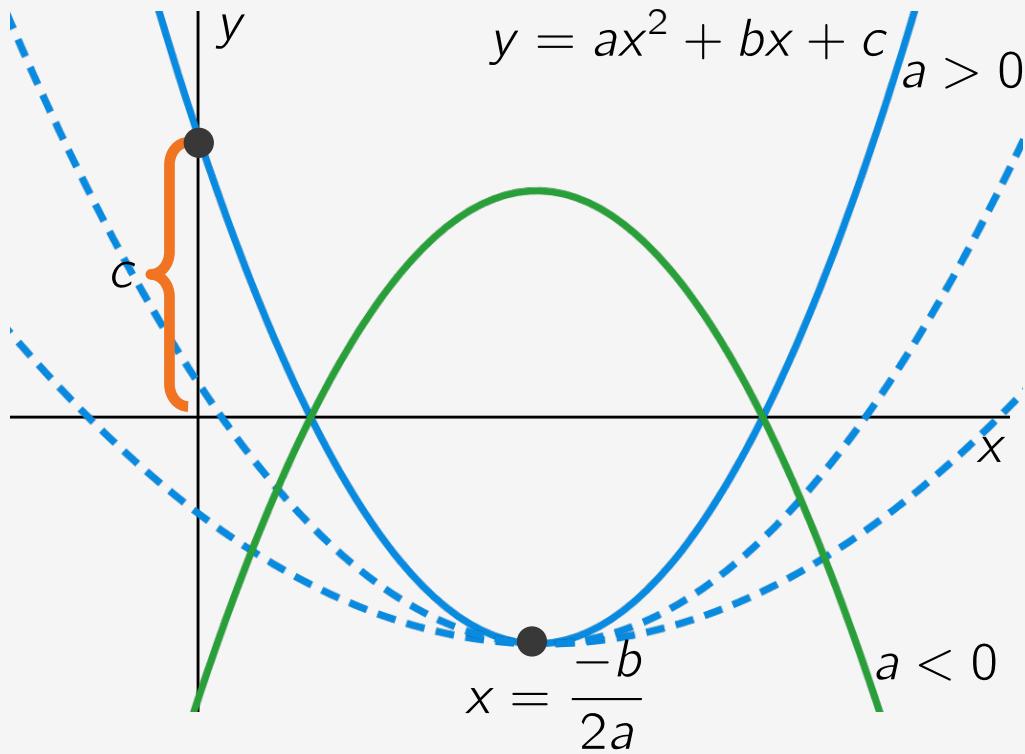


**Standard form:**

$$f(x) = ax^2 + bx + c$$

**Graph:** parabola

# Degree 2: quadratic functions



**Standard form:**

$$f(x) = ax^2 + bx + c$$

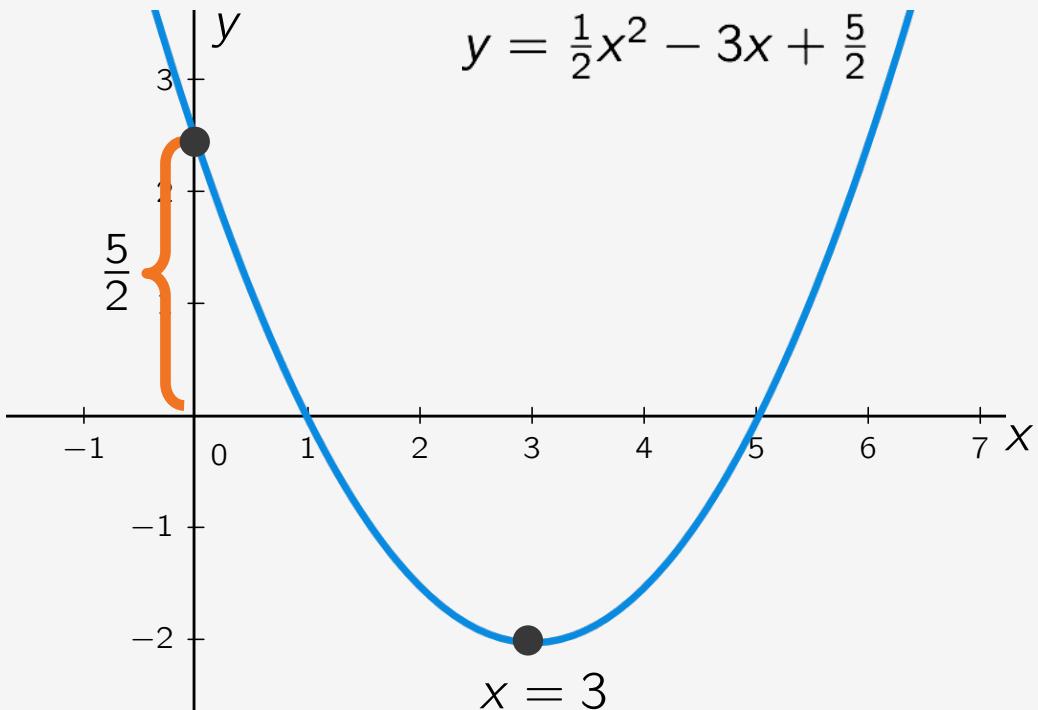
**Graph:** parabola

$a$  = wideness and orientation

$\frac{-b}{2a}$  = x-position vertex

$c$  = y - intercept

## Degree 2: example



**Example:**

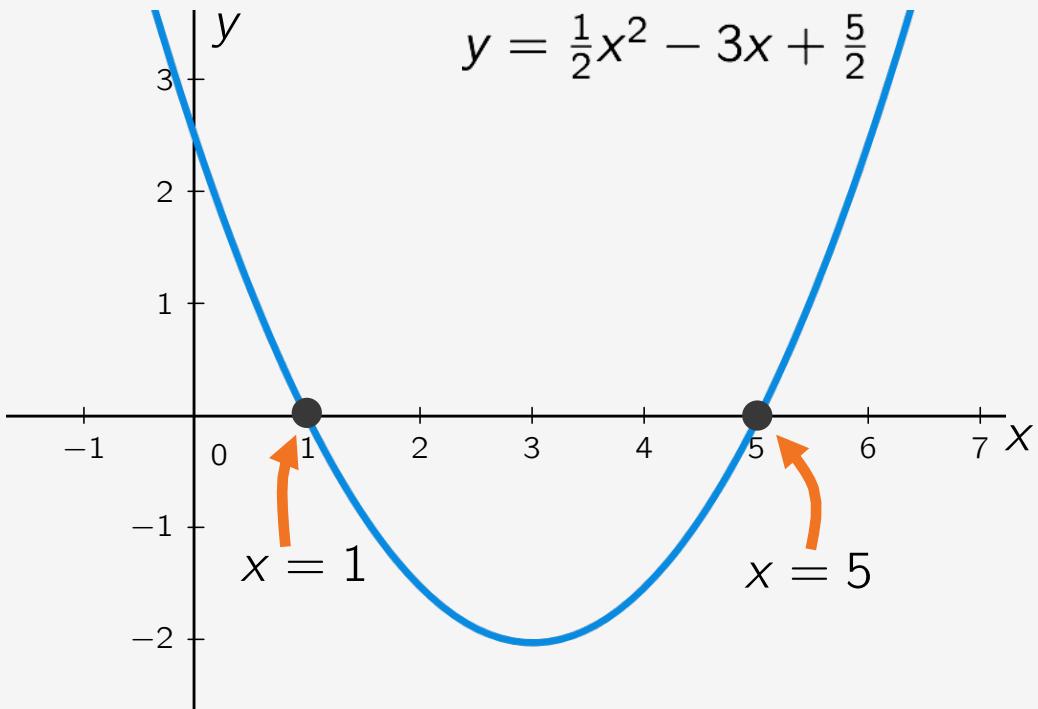
$$f(x) = \frac{1}{2}x^2 - 3x + \frac{5}{2}$$

$x$ - coordinate vertex:

$$x = \frac{-(-3)}{2 \cdot \frac{1}{2}} = 3$$

$y$ - intercept:  $\frac{5}{2}$

# Degree 2: alternate forms



**Factorized form:**

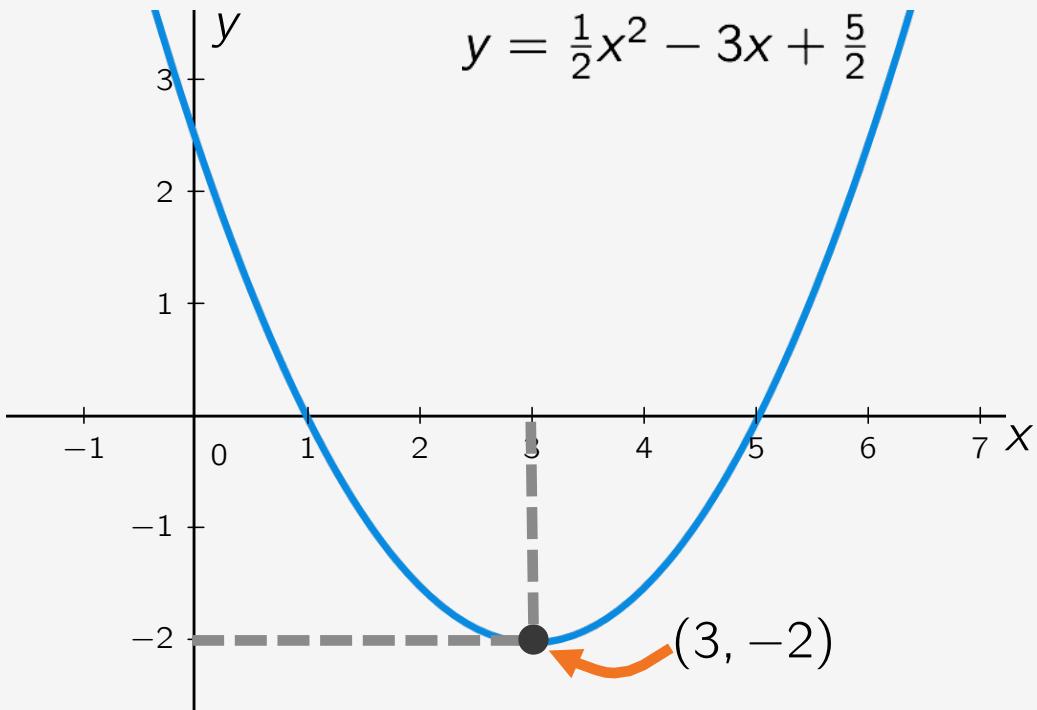
$$f(x) = a(x - p)(x - q)$$

Graph intersects  $x$ -axis  
at  $x = p$  and  $x = q$

**Example:**

$$f(x) = \frac{1}{2}(x - 1)(x - 5)$$

# Degree 2: alternate forms



**Complete-square form:**

$$f(x) = a(x - r)^2 + s$$

**Vertex at  $(r,s)$**

**Example:**

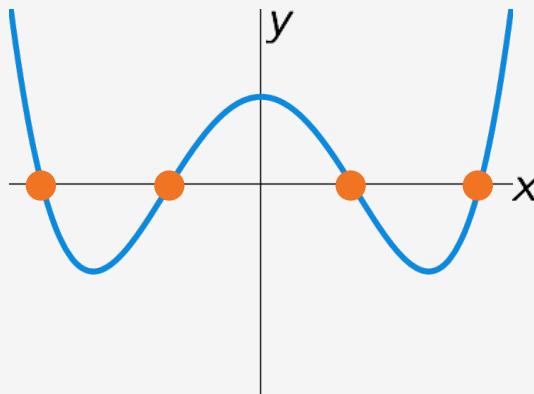
$$f(x) = \frac{1}{2}(x - 3)^2 - 2$$

# Higher degree

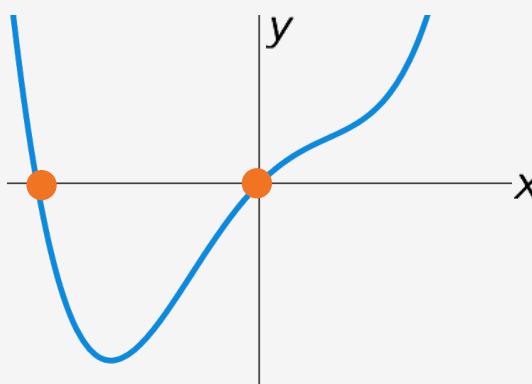
Degree  $n$ :  $f(x) = a_nx^n + \dots + a_0$

Graph intersects x-axis in  **$n$  points or fewer.**

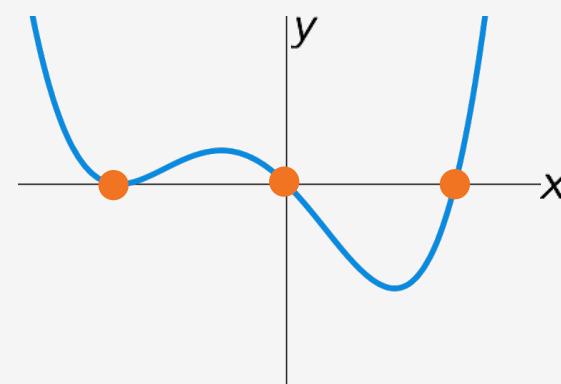
$$y = x^4 - 2x^2 + \frac{1}{2}$$



$$y = x^4 - x^2 + x$$



$$y = x^4 + x^3 - x^2 - x$$



f(x)

# Thank you for your attention!

TU Delft



photo: Jorrit Lousberg