

# Sesión 10.1: Multiverse of Madness

**CS3102 EDA**



# Índice

1. Maldición de la dimensionalidad
2. Métodos de Acceso Métrico





# 1 ● Maldición de la Dimensionalidad

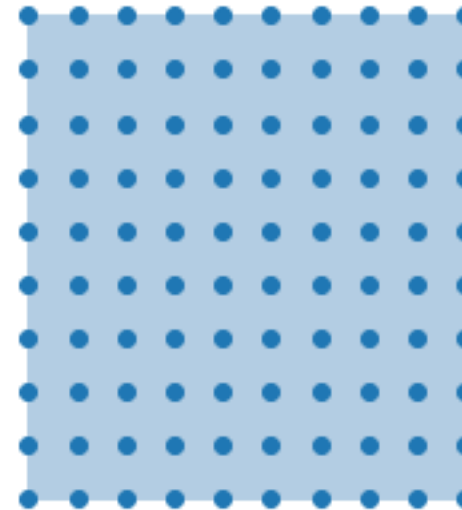


# Combinatorial *explosion*

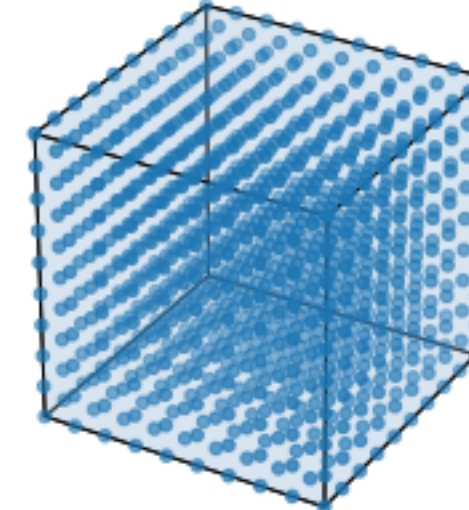
$d = 1$



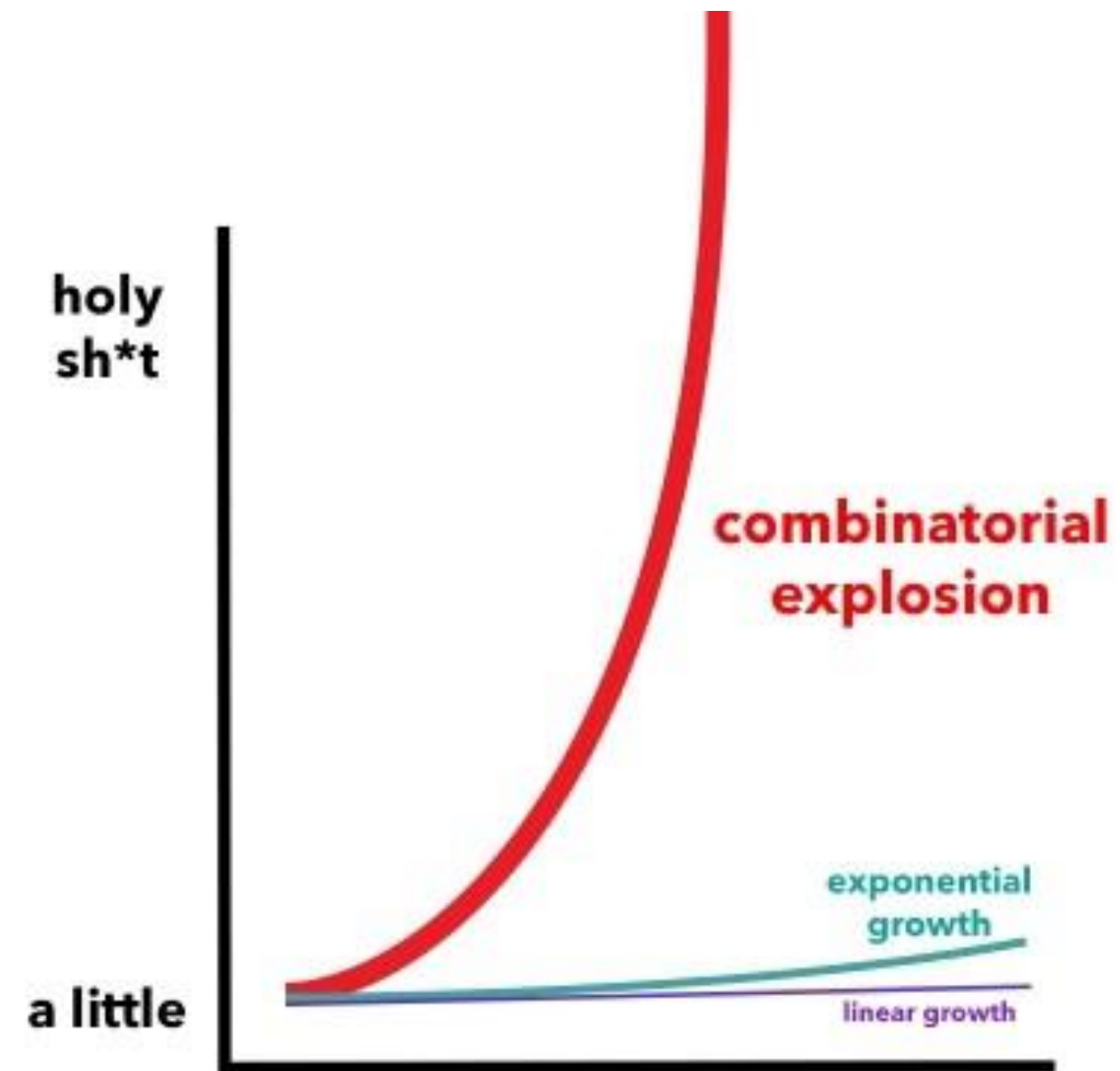
$d = 2$



$d = 3$

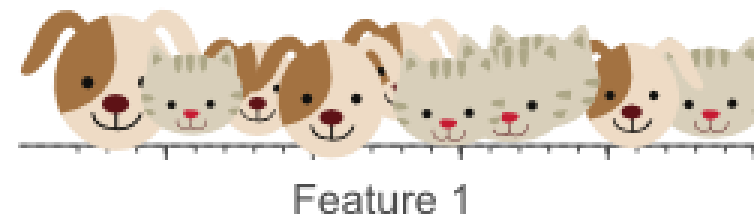


# Combinatorial *explosion*



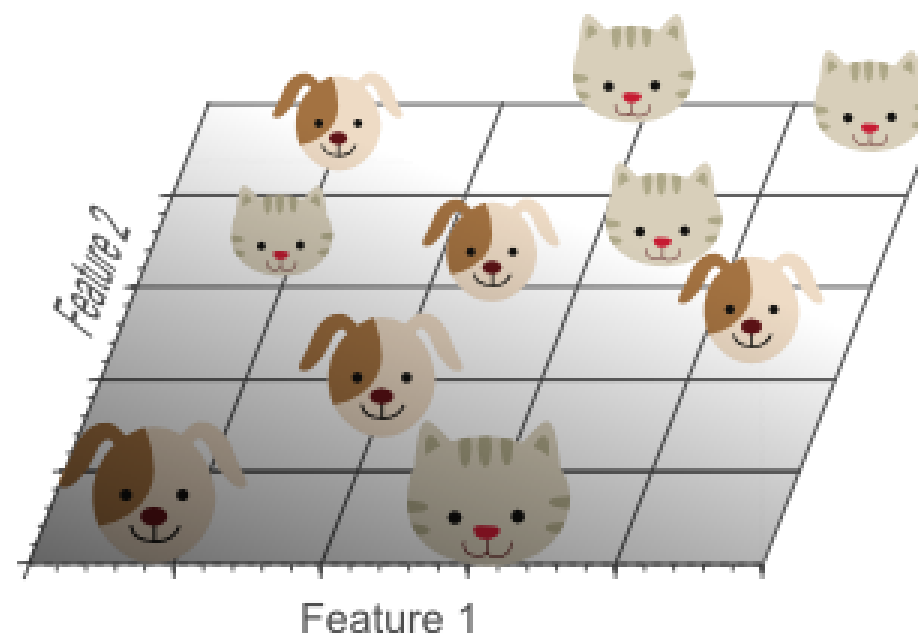
# Muestreo

Una dimensión



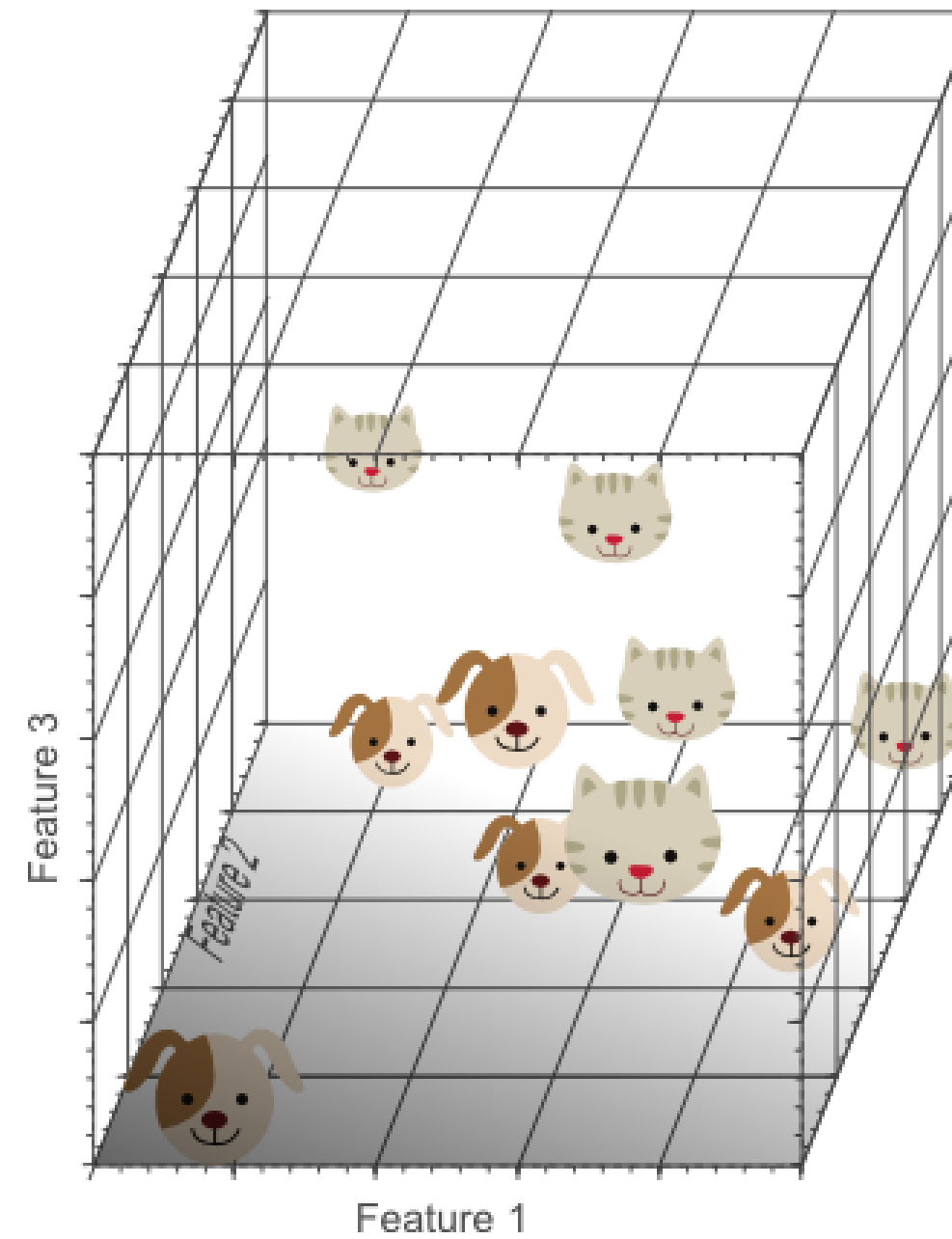
# Muestreo

Dos dimensiones



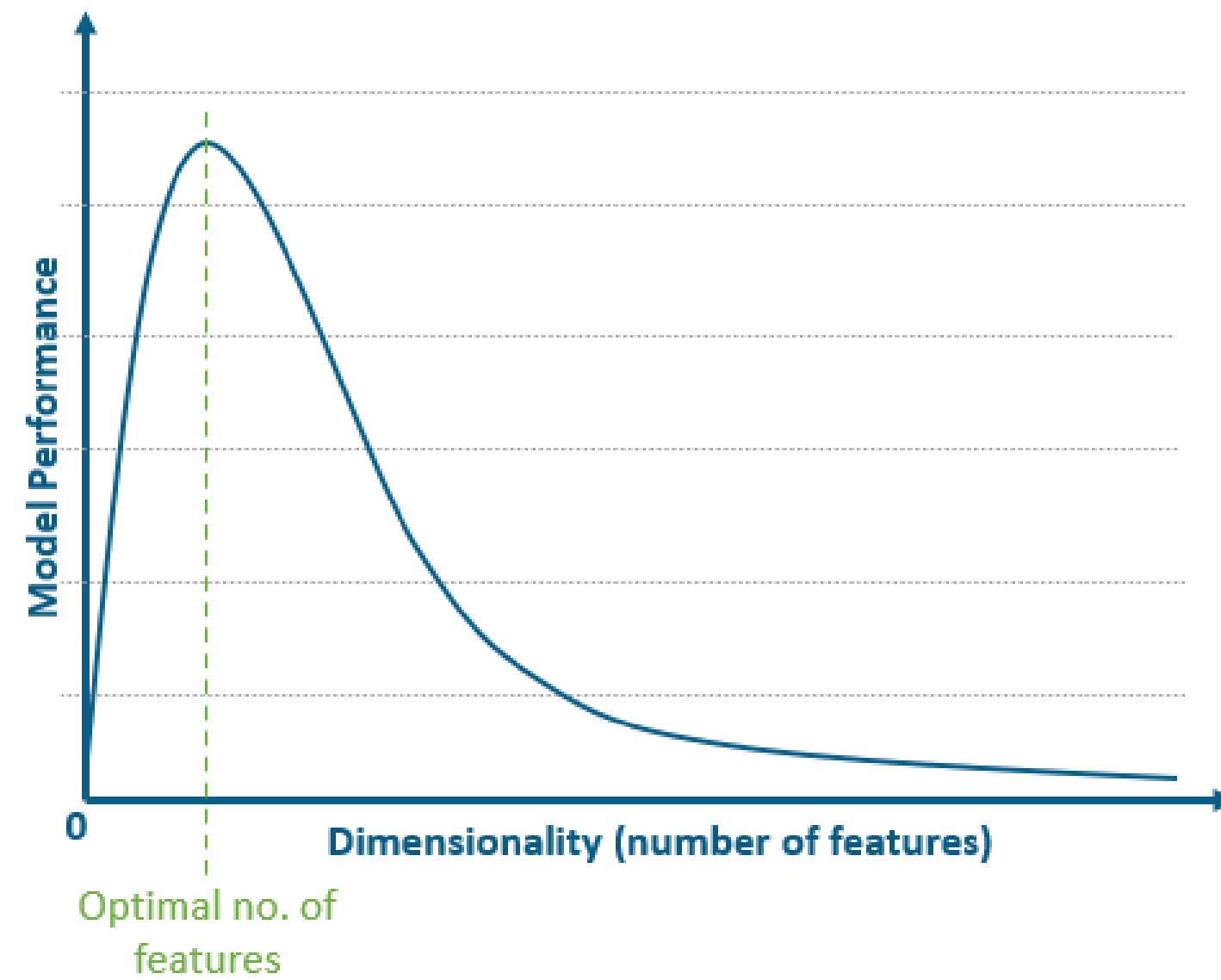
# Muestreo

Tres dimensiones

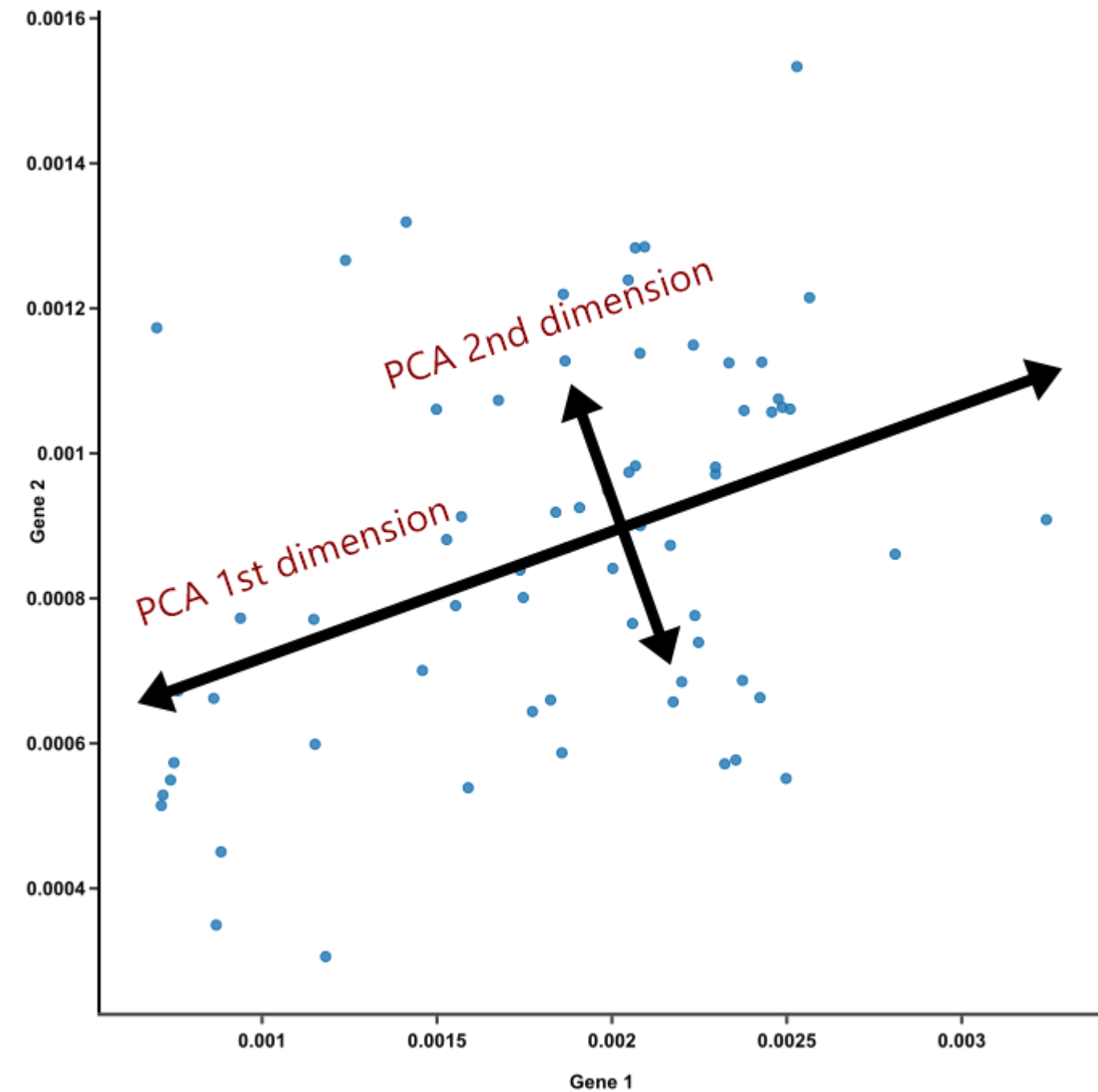
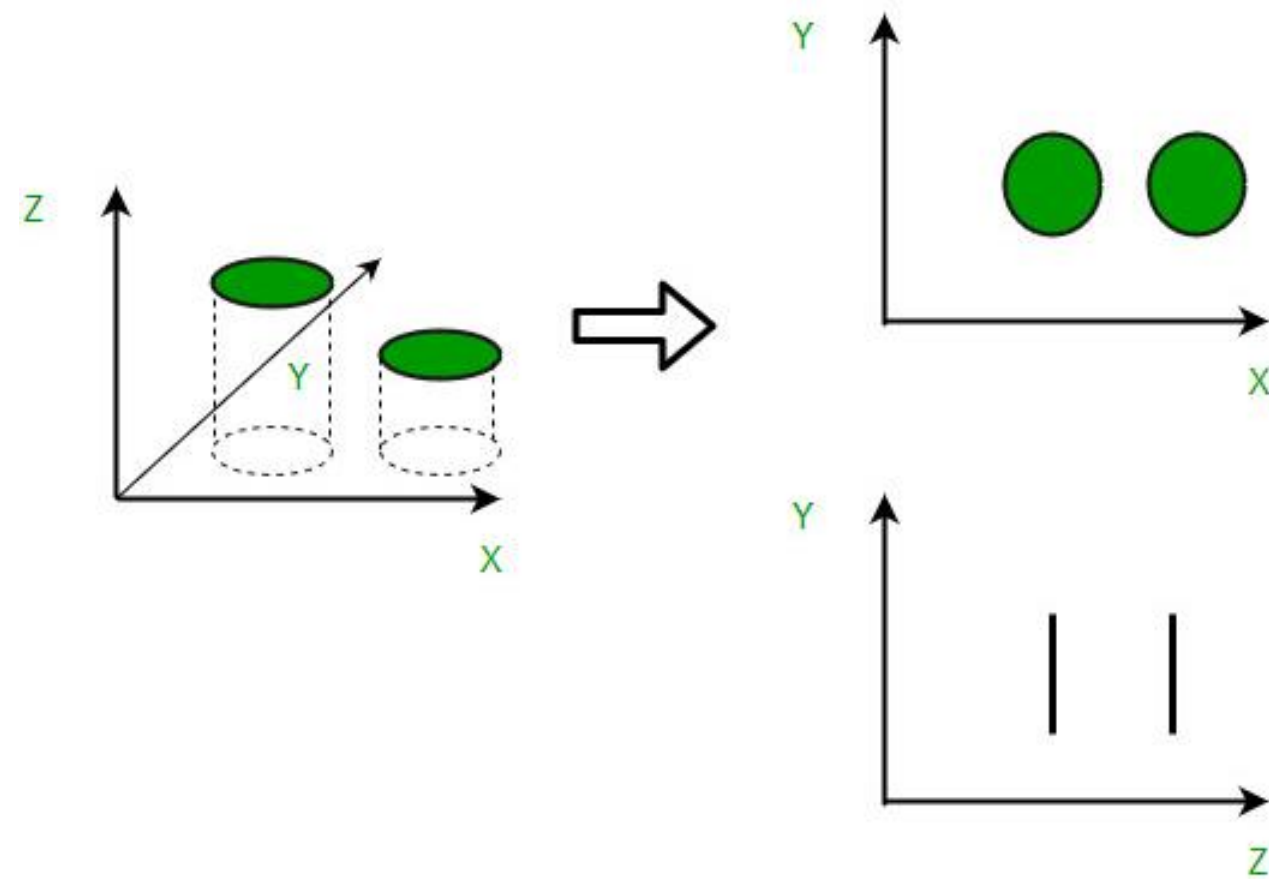




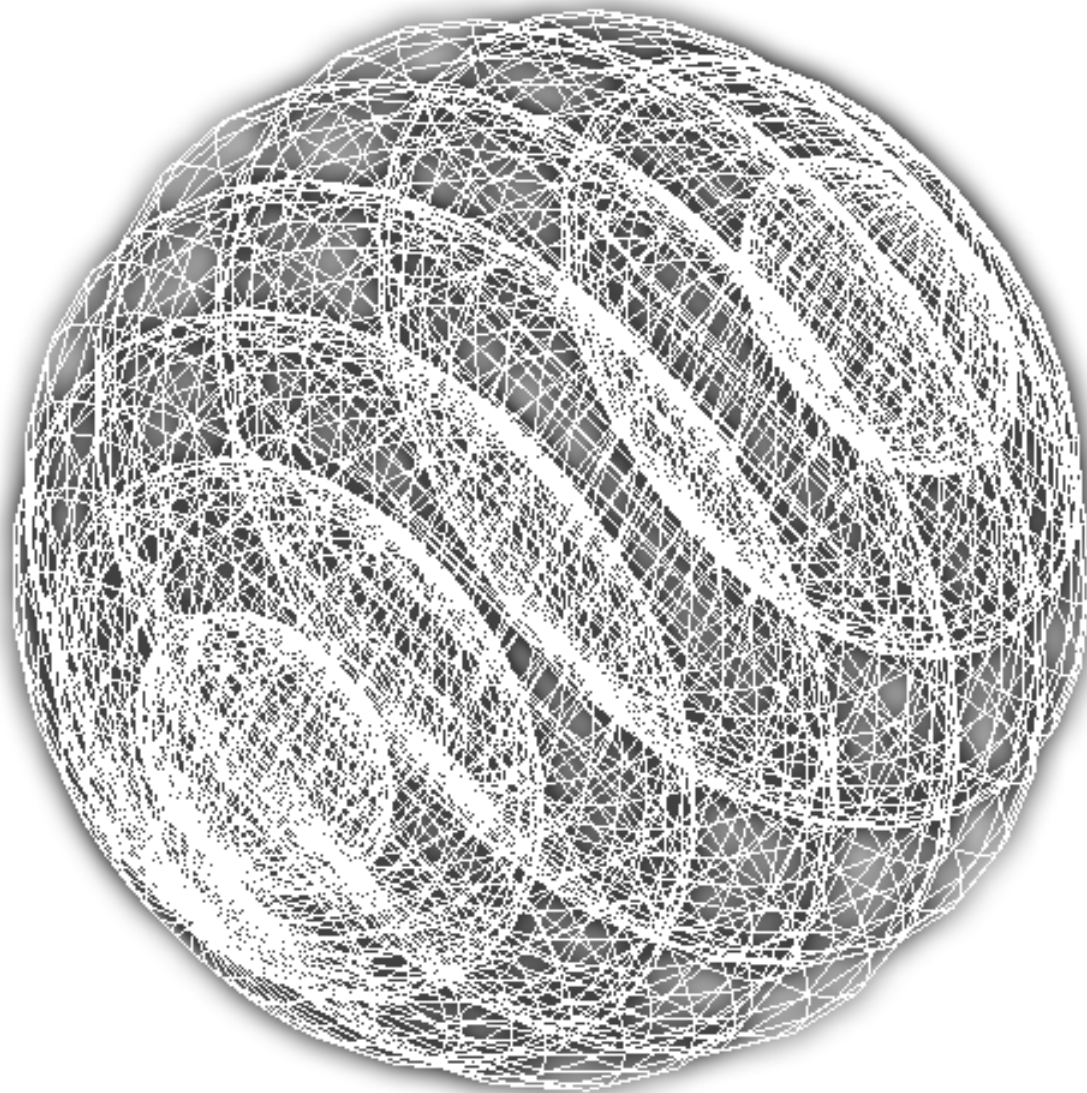
# Hughes Phenomenon



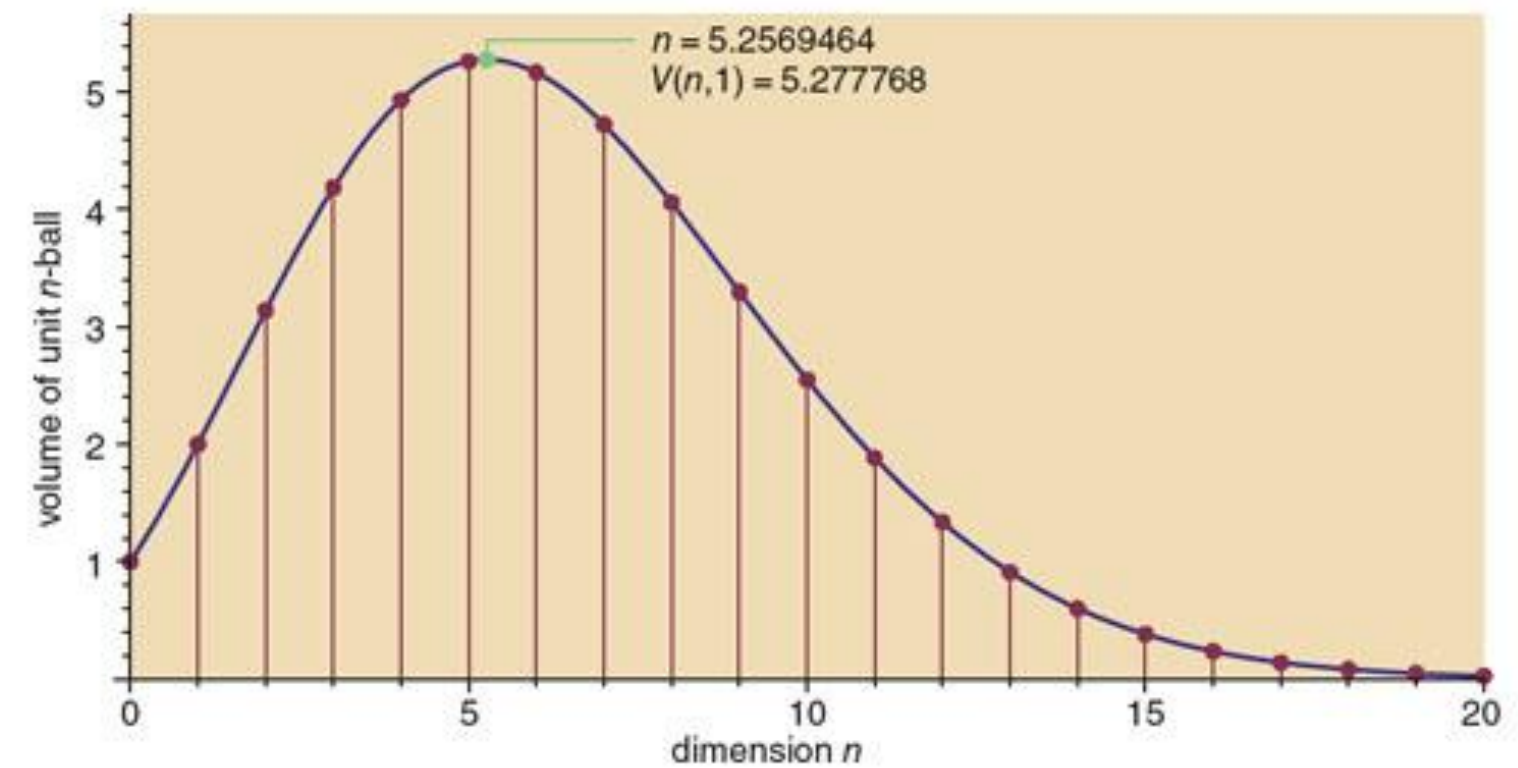
# Reducción de *Dimensionalidad*



# Maldición de la *Dimensionalidad*

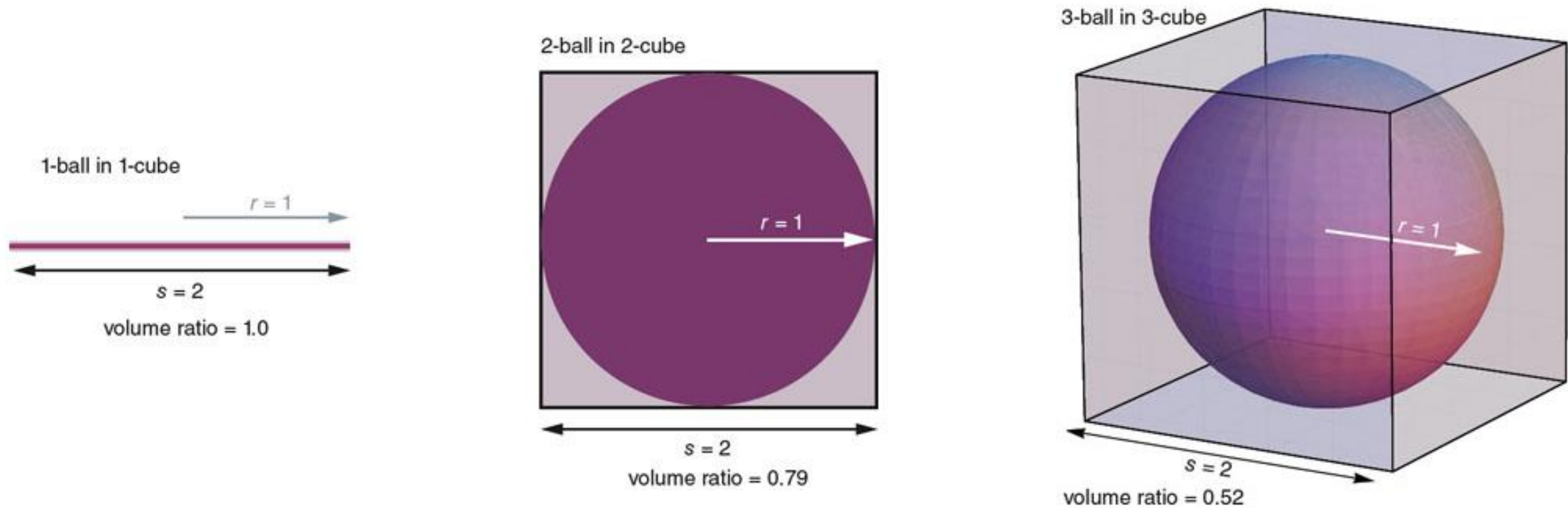


$$V_n = \frac{\pi^{n/2} R^n}{\Gamma\left(1 + \frac{n}{2}\right)} = \frac{\pi^{n/2} R^n}{\left(\frac{n}{2}\right)!}$$





# **Maldición de la** *Dimensionalidad*



# Maldición de la *Dimensionalidad*



# 2. Métodos de Acceso Métrico



# Espacio métrico

$$M = (D, d) \qquad d: M \times M \rightarrow \mathbb{R}$$

Dominio de  
los datos
 Función  
distancia

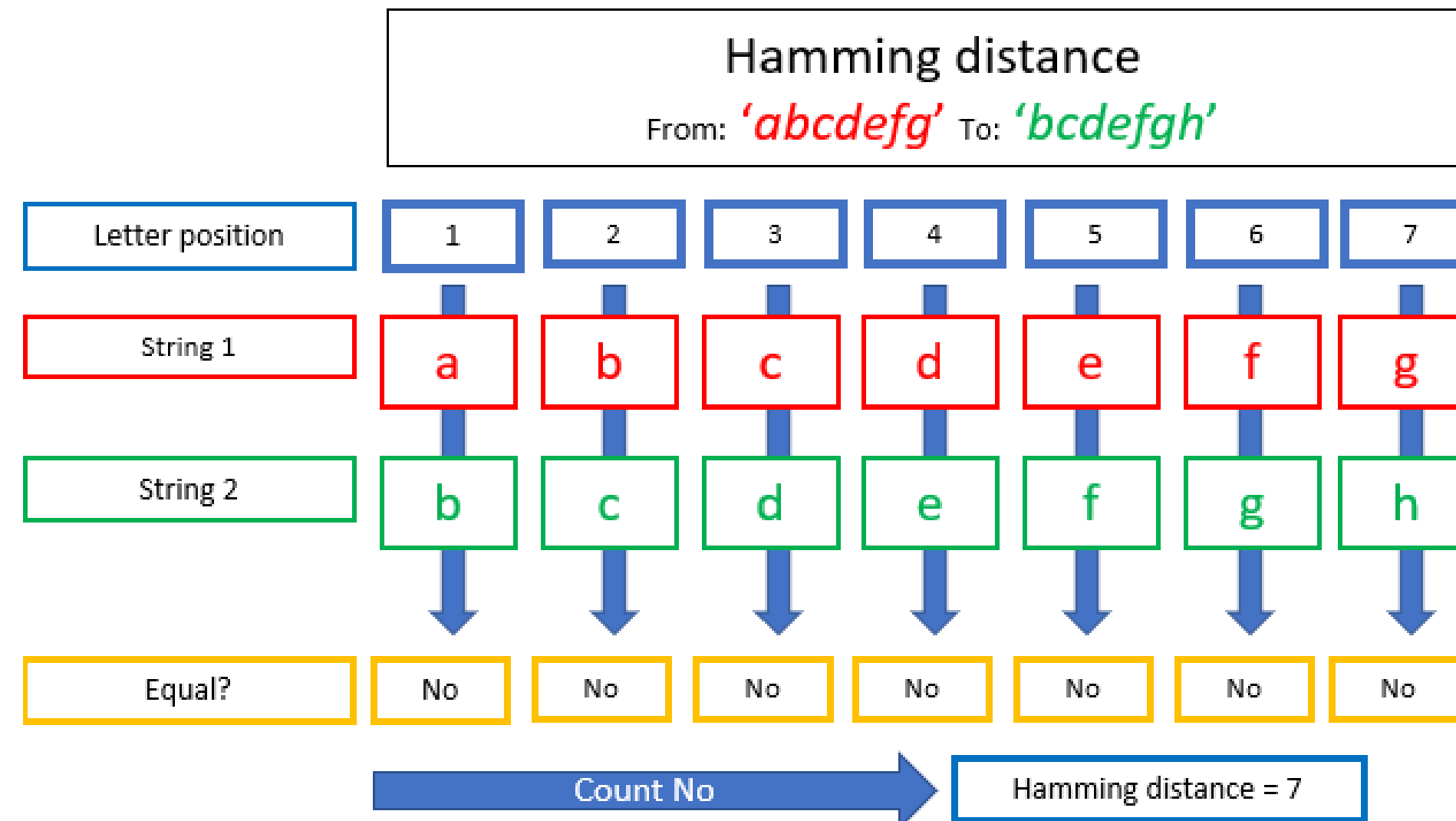
Simetría:  $d(x, y) = d(y, x)$

Identidad:  $x = y \leftrightarrow d(x, y) = 0$

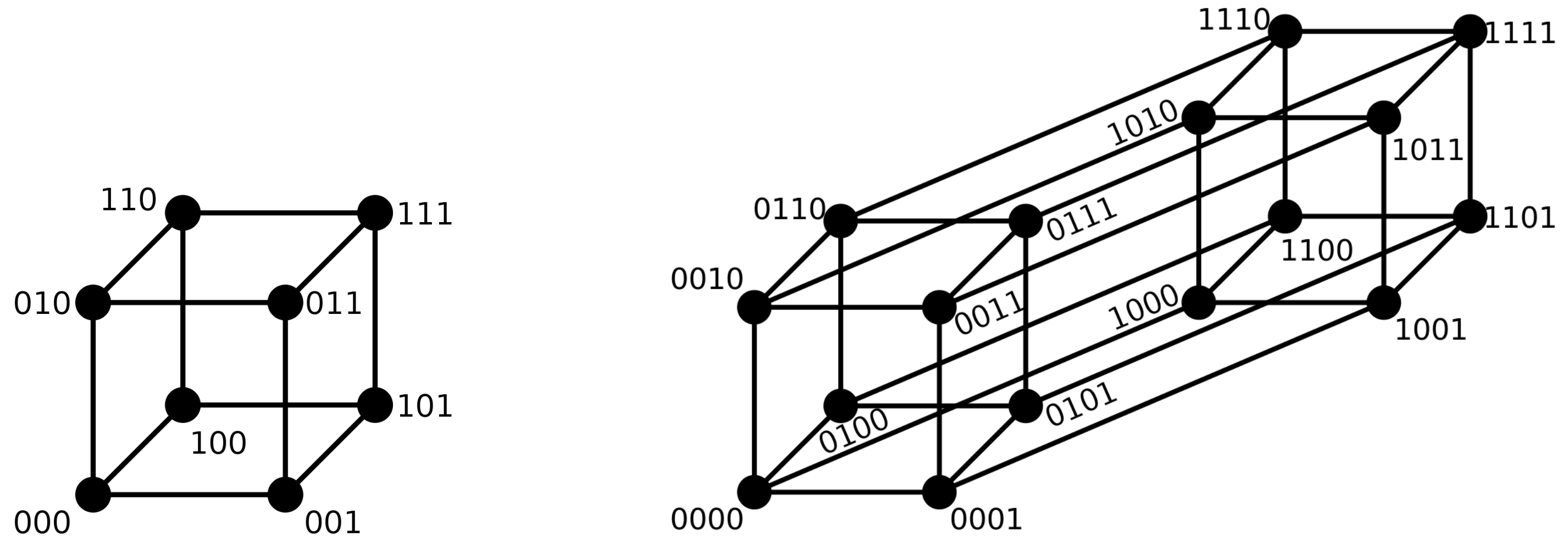
Desigualdad triangular:  $d(x, z) \leq d(x, y) + d(y, z)$

No negatividad:  $d(x, y) \geq 0$

# Distancia *Hamming*

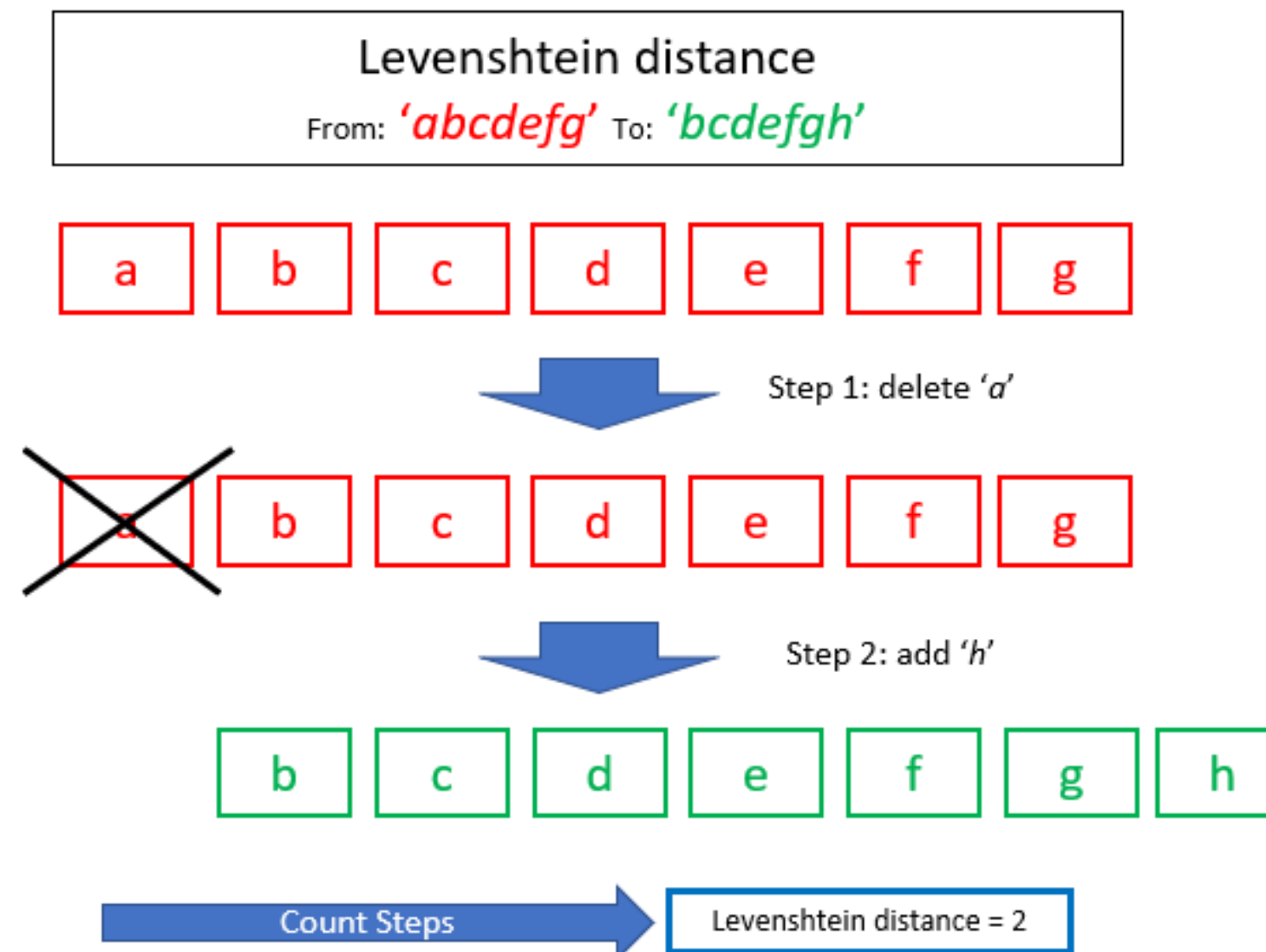


# Distancia *Hamming*





# Distancia *Levenshtein*

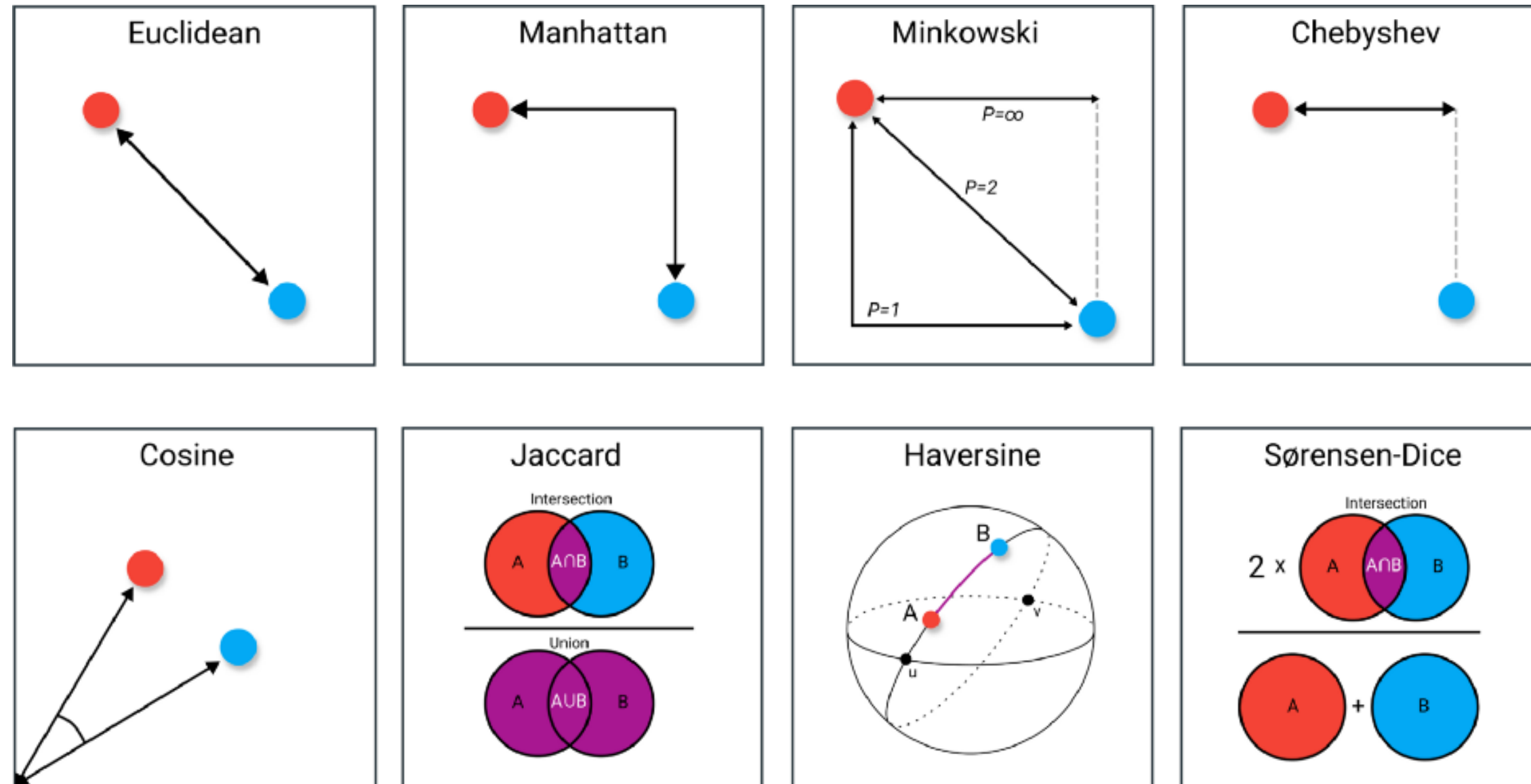


# Distancia *Levenshtein*

$$\text{lev}(a, b) = \begin{cases} |a| & \text{if } |b| = 0, \\ |b| & \text{if } |a| = 0, \\ \text{lev}(\text{tail}(a), \text{tail}(b)) & \text{if } a[0] = b[0], \\ 1 + \min \begin{cases} \text{lev}(\text{tail}(a), b) \\ \text{lev}(a, \text{tail}(b)) \\ \text{lev}(\text{tail}(a), \text{tail}(b)) \end{cases} & \text{otherwise,} \end{cases}$$

		h	e	l	l	o
	0	1	2	3	4	5
k	1	1	2	3	4	5
e	2	2	1	2	3	4
l	3	3	2	1	2	2
m	4	4	3	2	2	3

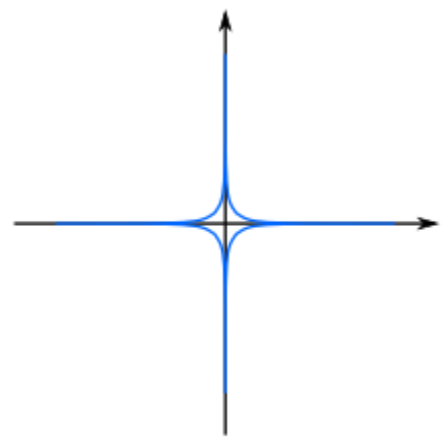
# Métricas continuas



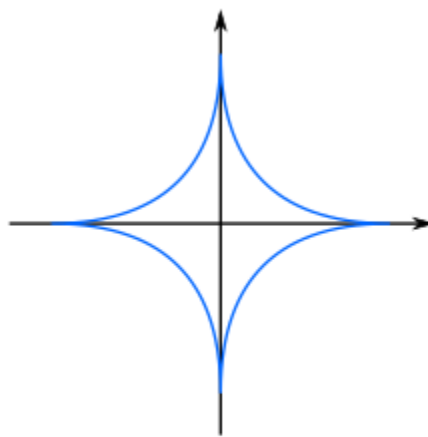


# Distancias *Minkowski*

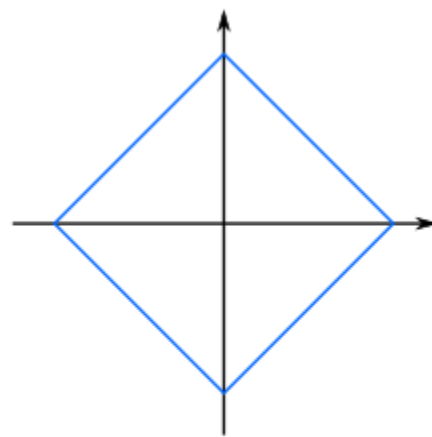
$$D(X, Y) = \left( \sum_{i=1}^n |x_i - y_i|^p \right)^{\frac{1}{p}}.$$



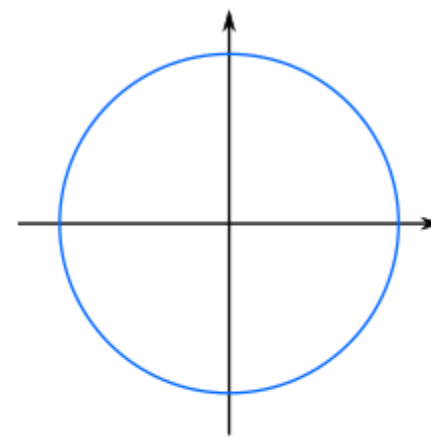
$$p = 2^{-2} \\ = 0.25$$



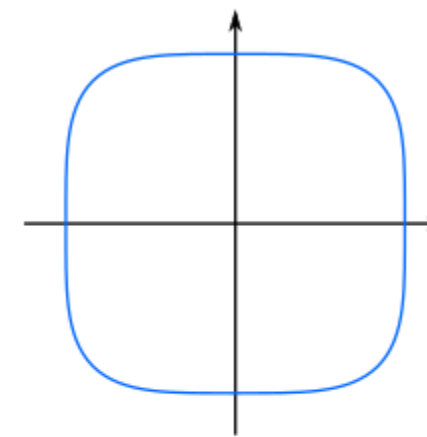
$$p = 2^{-1} \\ = 0.5$$



$$p = 2^0 \\ = 1$$

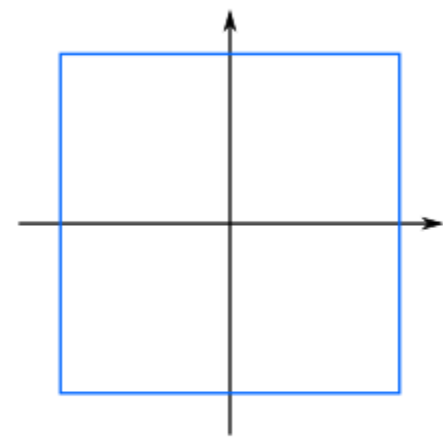


$$p = 2^1 \\ = 2$$



$$p = 2^2 \\ = 4$$

...



$$p = 2^\infty \\ = \infty$$

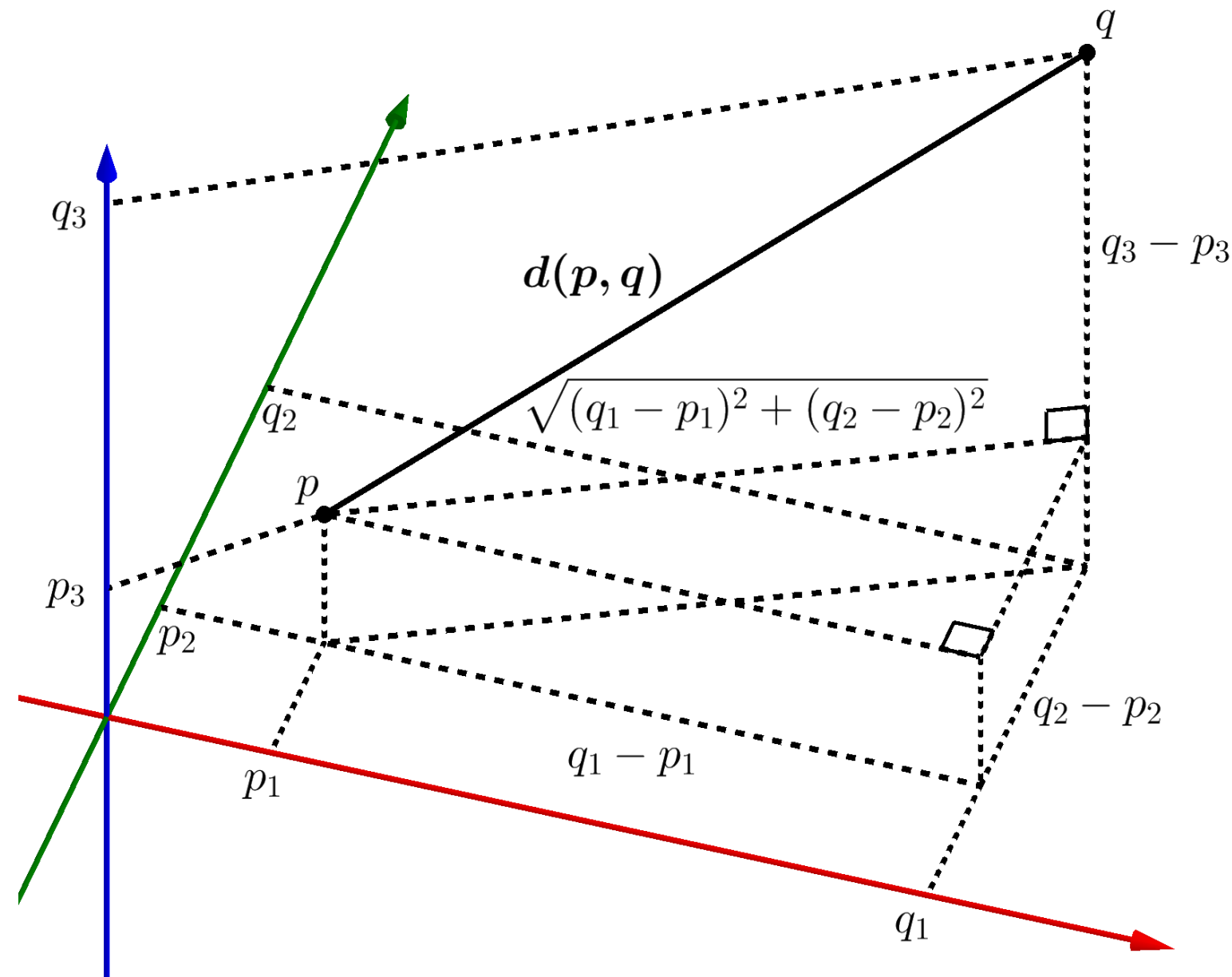
# Distancia Manhattan



$$d_T(\mathbf{p}, \mathbf{q}) = \|\mathbf{p} - \mathbf{q}\|_T = \sum_{i=1}^n |p_i - q_i|$$



# Distancia Euclidiana




$$d(\mathbf{p}, \mathbf{q}) = \sqrt{\sum_{i=1}^n (q_i - p_i)^2}$$



# Distancia Chebyshev

$$d_{\infty}(x, y) = \lim_{p \rightarrow \infty} \left( \sum_{i=1}^n |x_i - y_i|^p \right)^{1/p}$$

$$d_{\infty}(x, y) = \max_i (|x_i - y_i|)$$

	a	b	c	d	e	f	g	h	
8	5	4	3	2	2	2	2	2	8
7	5	4	3	2	1	1	1	2	7
6	5	4	3	2	1		1	2	6
5	5	4	3	2	1	1	1	2	5
4	5	4	3	2	2	2	2	2	4
3	5	4	3	3	3	3	3	3	3
2	5	4	4	4	4	4	4	4	2
1	5	5	5	5	5	5	5	5	1
	a	b	c	d	e	f	g	h	

$$d_{\infty}(x, y) = \max(|x_2 - x_1|, |y_2 - y_1|)$$





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