what's your favorite programming language?

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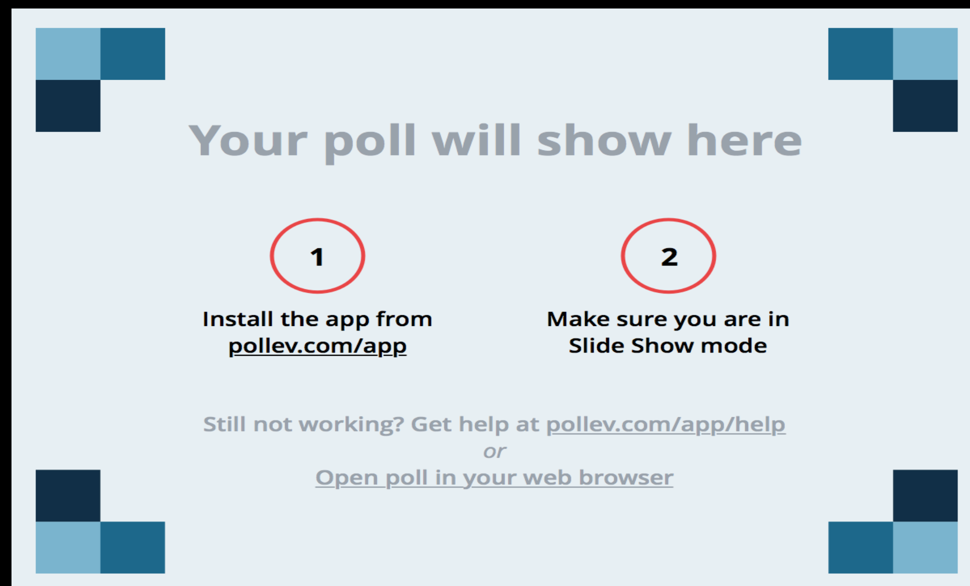


Norms

Norms

For all $a \in R$ **and all** $\mathbf{u}, \mathbf{v} \in V$,

- $L_p(a\mathbf{v}) = |a|\, L_p(\mathbf{v})$
- $L_p(\mathbf{u} + \mathbf{v}) \leq L_p(\mathbf{u}) + L_p(\mathbf{v})$
  - *triangle inequality* or *subadditivity*
- If $L_p(\mathbf{v}) = 0$ then $\mathbf{v}$ is the zero vector
  - implies $|\mathbf{v}| = 0$ *iff* $\mathbf{v}$ is the zero vector

L_p norm: $\left(\sum_j |x_j|^p\right)^{1/p}$

What is

$|(1,2,3)|_1$?

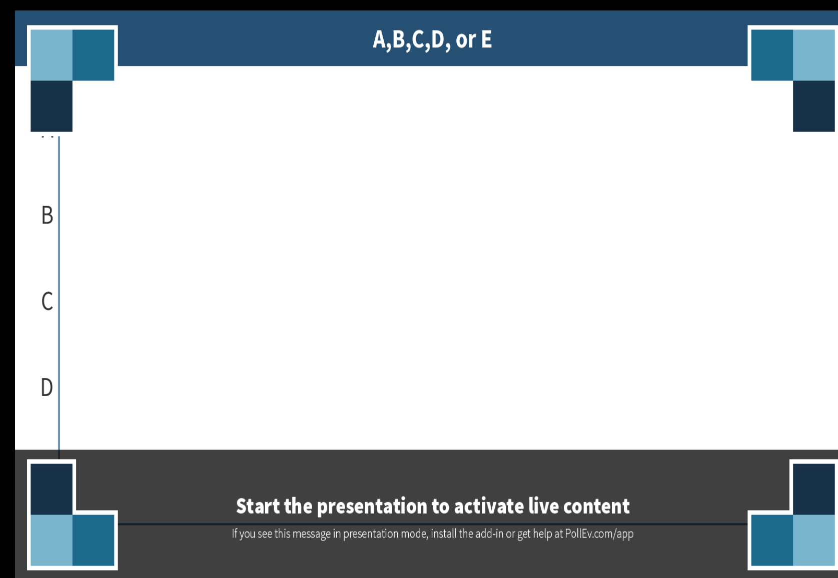
A) 1

B) 3

C) sqrt(14)

D) sqrt(14/3)

E) none of the above



What is

$|(1,2,3)|_2$?

A) 1

B) 3

C) sqrt(14)

D) sqrt(14/3)

E) none of the above

What is

$|(1,2,3)|_{1/2}$?

A) 1

B) 3

C) sqrt(14)

D) sqrt(14/3)

E) none of the above

What is

$\|(1,2,3)\|_0$?

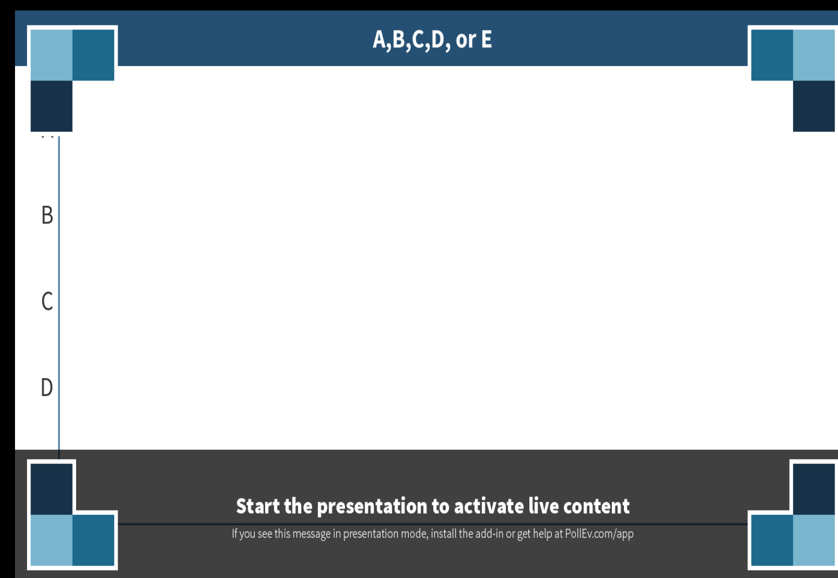
A) 1

B) 3

C) sqrt(14)

D) sqrt(14/3)

E) none of the above



L_0 pseudo-norm

$|\mathbf{x}|_0$ = number of $x_j \neq 0$

How is this not a real norm?

Norms

Is $|x|_{1/2}$ convex?

Distance

- How do norms relate to distance?

Distance

- How do norms relate to distance?

$$d_p(\mathbf{x},\mathbf{y}) = |\mathbf{x}-\mathbf{y}|_p$$

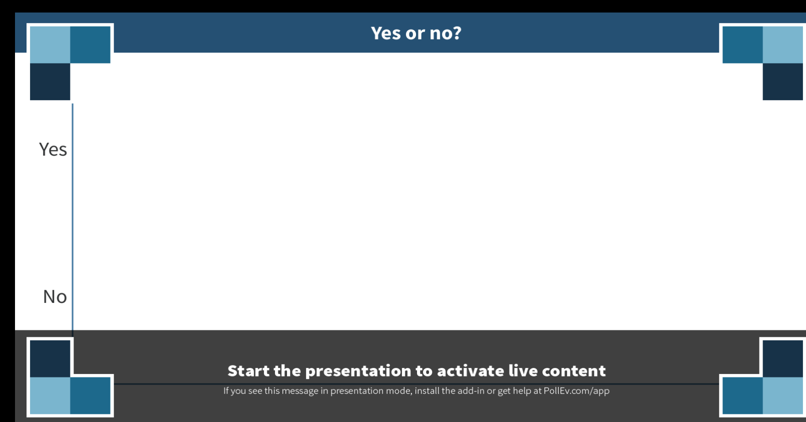
Kernel

A symmetric function K: $\boldsymbol{X} \times \boldsymbol{X} \rightarrow \mathbb{R}$
is a positive semi-definite (psd) kernel on $\boldsymbol{X}$ if

$$\sum_{i,j} c_i c_j K(\mathbf{x}_i, \mathbf{x}_j) \geq 0$$

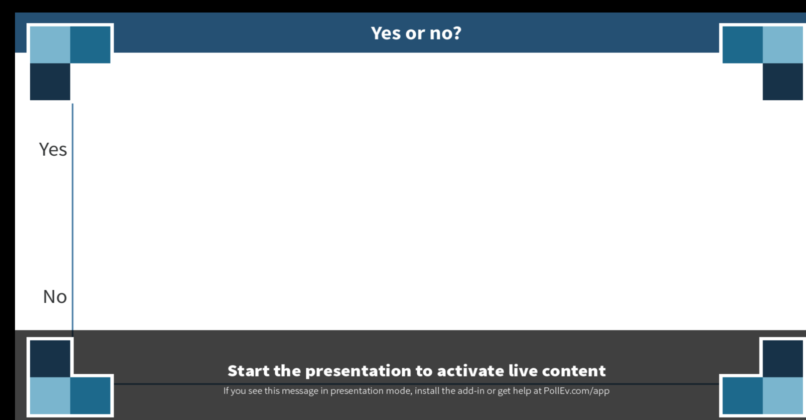
If x is a vector containing only non-negative numbers, is the following a norm?

$\Sigma_i \; \mathbf{x}_i$ - the sum of the elements of x



If x is a vector containing only non-negative numbers, is the following a norm?

$\Sigma_i \, \boldsymbol{i} \, \boldsymbol{x}_i$ - the sum of the elements of x, each weighted by it’s index, i

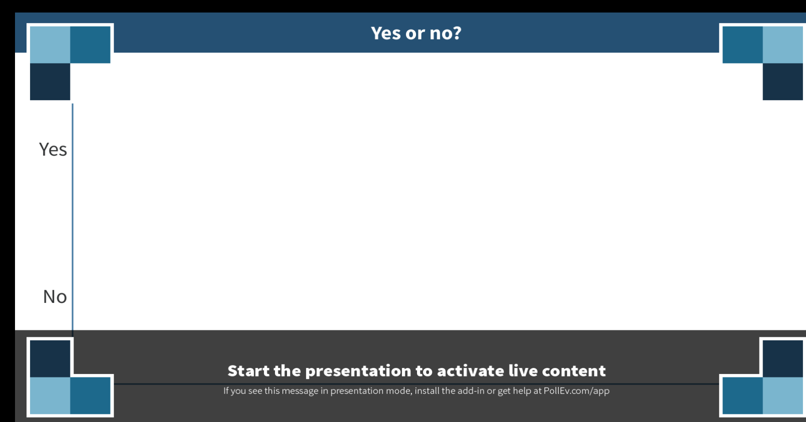


If x is a vector containing only non-negative numbers, is the following a norm?

$$\Sigma_i \; \mathbf{x}_i^2$$

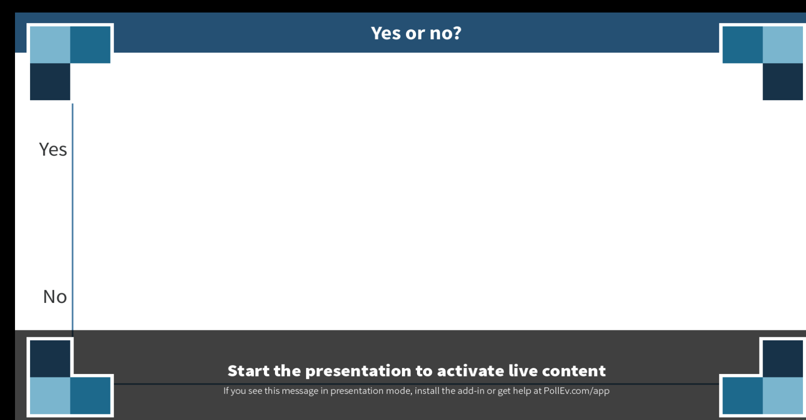
If x is a vector containing only non-negative numbers, is the following a norm?

length(x) - number of the elements of x



If x is a vector containing only non-negative numbers, is the following a norm?

$d(x,y)$ - the Euclidean distance between x and some other (arbitrary, but fixed, vector y, also non-negative)



True or False: The only important thing you need to pick which doing k-nearest neighbors is k