what's your favorite programming language?

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Norms

Norms

For all $a \in R$ and all $u, v \in V$,

- $L_p(a\mathbf{v}) = |a|\, L_p(\mathbf{v})$
- $L_p(\mathbf{u} + \mathbf{v}) \leq L_p(\mathbf{u}) + L_p(\mathbf{v})$
  - *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: $(\Sigma_j\, |x_j|^p)^{1/p}$

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

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

If *x* is a vector containing only non-negative numbers, does the following satisfy the 3 properties of a norm?

$\Sigma_j \; \mathbf{x}_j$ - the sum of the elements of x

Technically, that doesn't make it a norm, since the criteria should hold over a full vector space

If x is a vector containing only non-negative numbers, does the following satisfy the 3 properties of a norm?

$\Sigma_j \, \boldsymbol{j} \, \boldsymbol{x}_j$ - the sum of the elements of x, each weighted by it's index, j

If *x* is a vector containing only non-negative numbers, does the following satisfy the 3 properties of a norm?

$$\Sigma_j \; \mathbf{x}_j^2$$

If *x* is a vector containing only non-negative numbers, does the following satisfy the 3 properties of a norm?

length(*x*) - number of the elements of x

If *x* is a vector containing only non-negative numbers, does the following satisfy the 3 properties of 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