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$$\big|\|x\| - \|y\|\big| \leq \|x - y|$$

↓ Proof

$\|x\| = \|x + y - y\|$

then, we put $A = x - y$,

$$\|x\| = \|A + y\| \leq \|A\| + \|y\|$$

$$\|x\| \leq \|A\| + \|y\|$$

$$\|x\| - \|y\| \leq \|A\|$$

$$\|x\| - \|y\| \leq \|x - y\| \quad ①$$

on the other hand,

$\|y\| = \|y + x - x\|$

then, we put $B = y - x$.

$$\|y\| = \|B + x\| \leq \|B\| + \|x\|$$

$$\|y\| \leq \|B\| + \|x\|$$

$$\|y\| - \|x\| \leq \|B\|$$

$$\|y\| - \|x\| \leq \|y - x\| \quad ②$$

$$\begin{cases} \|x\| - \|y\| \leq \|x - y\| & ① \\ \|y\| - \|x\| \leq \|y - x\| & ② \end{cases}$$

then, we can say $\|x - y\| = \|y - x\|$

so, we can get $\big|\|x\| - \|y\|\big| \leq \|x - y\|$