Pairs of Quantifiers

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Paired quantifiers $\exists, \exists$

- There exists $x \in A$ so that there exists $y \in B$ so that $P(x, y)$

There exists $x \in \mathbb{N}$ so that there exists $y \in \mathbb{N}$ so that $x + y = 5$.

$\forall, \forall$

- For all $x \in A$ and for all $x \in B$, $P(x, y)$.

For all $x \in \mathbb{N}$ and for all $y \in \mathbb{N}$, $xy > 0$.

For all $x \in \mathbb{Z}$ and for all $y \in \mathbb{N}$, $xy > 0$.

$\forall, \exists$

- For all $x \in A$ there exists $y \in B$ so that $P(x, y)$.

For all $x \in \mathbb{N}$ there exists $y \in \mathbb{N}$ so that $2y = x$.

For all $x \in \mathbb{Z}$ there exists $y \in \mathbb{Q}$ so that $2y = x$.

For all $\epsilon \in \mathbb{R}$ with $\epsilon > 0$, there exists $\delta \in \mathbb{R}$ with $\delta > 0$ so that $x^2 < \epsilon$ when $x < \delta$.

$\exists, \forall$

- There exists $x \in A$ so that for all $y \in B$ we have $P(x, y)$.

There exists $x \in \mathbb{N}$ so that for all $y \in \mathbb{N}$ we have $xy > 1$.

There exists $x \in \mathbb{Q}$ so that for all $y \in \mathbb{Q}$ we have $xy < y$.