Let \( n \) be a natural number, and let \( R \) be a relation on \( 0..n \). In other words,
\[
R : (0..n) \to (0..n) \to \text{bin}
\]
We say that from \( x \) we can reach \( x \) in zero steps. If \( R x y \) we say that from \( x \) we can reach \( y \) in one step. If \( R x y \) and \( R y z \) we say that from \( x \) we can reach \( z \) in two steps. And so on. Express formally that from \( x \) we can reach \( y \) in some number of steps.

\[
x = y \lor \exists s : \text{nat} \forall n : 0..\#s+1 \cdot R ([x; s; y] n) ([x; s; y] (n+1))
\]

Here is another solution. I omit domains, which are always \( 0..n \). Define the relational composition \((R, S)\) of relations \( R \) and \( S \) as follows:
\[
R \cdot S = \langle x, y \cdot \exists z : \forall R x z \land S z y \rangle
\]
Now define relational power \( R^m \) for relation \( R \) and natural \( m \) as follows:
\[
R^0 = \langle x, y : x = y \rangle \quad \text{(the identity relation)}
\]
\[
R^{m+1} = R^m \cdot R
\]
Then \( R^m x y \) says that from \( x \) we can reach \( y \) in \( m \) steps, and \( \exists m : R^m x y \) says that from \( x \) we can reach \( y \) in some number of steps.