Relation $R$ is transitive if $\forall x, y, z : R x y \land R y z \Rightarrow R x z$. Express formally that relation $R$ is the transitive closure of relation $Q$ ($R$ is the strongest transitive relation that is implied by $Q$).

After trying the question, scroll down to the solution.
Here is a straightforward solution. Let $T R$ mean that $R$ is a transitive relation. Formally,
\[ T = \{ R : X \rightarrow X : \text{bin} \cdot \forall x, y, z : X \cdot R x y \land R y z \Rightarrow R x z \} \]
Let $A \geq B$ mean that relation $A$ is everywhere as strong as relation $B$. Formally,
\[ A \geq B = \forall x, y : X \cdot A x y \Rightarrow B x y \]
Then we can say that $R$ is the transitive closure of $Q$ as follows.
\[ T R \land Q \geq R \land \forall A : X \rightarrow X : \text{bin} \cdot T A \land Q \geq A \Rightarrow R \geq A \]
Here is a nicer solution, but only for the special case $X = 0..n$ for some extended natural $n$. Let $P i j k$ mean “there is a path in $Q$ from $j$ to $k$ via zero or more intermediate nodes all of which are less than $i$”. Formally,
\[ P 0 = Q \]
\[ \forall i, j, k : P (i+1) j k = P i j k \lor P i i \land P i k \]
Then we can say that $R$ is the transitive closure of $Q$ as follows:
\[ R = P n \]
This simple definition leads to a beautiful algorithm for transitive closure.