Implementer's variables \( p, q \): \textit{real} represent two points along a line. Each number tells the distance of one point from the origin (a standard point). They must be reimplemented by one implementer's variable \( r \): \textit{real} which tells the distance from \( p \) to \( q \). For examples, if \( p=3 \) and \( q=5 \), then \( r=2 \); if \( p=5 \) and \( q=3 \), then \( r=-2 \).

(a) What is the data transformer?

\[
\begin{align*}
& \forall p, q : r = q-p
\end{align*}
\]

(b) A user has binary variable \( b \) and operation

\[
\text{\textit{compare}} = b := q \geq p
\]

Use your transformer from part (a) to transform operation \textit{compare}.

\[
\begin{align*}
& \forall p, q : r = q-p \Rightarrow \exists p', q' : r' = q' - p' \wedge (b := q \geq p) & \text{expand assignment} \\
& \forall p, q : r = q-p \Rightarrow r' = q - p \wedge b' = (q \geq p) & \text{one-point twice} \\
& \forall p, q : r = q-p \Rightarrow r' = q - p \wedge b' = (q \geq p) & \text{context} \\
& \forall p, q : r = q-p \Rightarrow r' = r \wedge b' = (r \geq 0) & \text{some law of arithmetic} \\
& \forall p, q : p = q-r \Rightarrow r' = r \wedge b' = (r \geq 0) & \text{one-point and idempotent} \\
& r' = r \wedge b' = (r \geq 0) & \text{definition of assignment} \\
& b := r \geq 0
\end{align*}
\]