Definition (Trace of a design problem)
Given a design problem $\mathbf{d} : \mathbf{P} \times \mathbf{R} \nrightarrow \mathbf{Q} \times \mathbf{R}$, we can define its *trace* $\mathrm{Tr}^{\mathbf{R}}_{\mathbf{P},\mathbf{Q}}(\mathbf{d}) : \mathbf{P} \nrightarrow \mathbf{Q}$ as follows:

$$\mathrm{Tr}^{\mathbf{R}}_{\mathbf{P},\mathbf{Q}}(\mathbf{d}) : \mathbf{P}^{\mathrm{op}} \times \mathbf{Q} \to_{\mathbf{Pos}} \mathbf{Bool}$$

$$\langle a^*, b \rangle \mapsto \bigvee_{c \in \mathbf{R}} \mathbf{d}(\langle a, c \rangle^*, \langle b, c \rangle).$$