1. Check whether $\models_{\{ref,tr\}} \Diamond\Box(p \vee \Box(p \rightarrow \bot))$ using the terminating algorithm for S4. If the formula is not valid, produce a countermodel.

2. Let $\mathcal{M}^\times$ be the countermodel for a sequent $\mathcal{S}$ as defined in Slide 20. Verify that $\mathcal{M}^\times$ satisfies the frame conditions ref, tr.
   Then, for $\rho^\times(x) = x$, for each label x occurring in $\mathcal{S}$, verify that the Truth Lemma holds, for the cases:
   - If $x{:}\Box A$ occurs in Γ, then $\mathcal{M}^\times, \rho^\times \models x{:}\Box A$
   - If $x{:}\Box A$ occurs in Δ, then $\mathcal{M}^\times, \rho^\times \not\models x{:}\Box A$