1 True is Terminal

Provide a second order logic derivation for $\vdash (\forall P. (P \rightarrow Q)) \rightarrow Q$

2 False is Initial

Provide a second order logic derivation for $\vdash (\forall Q. (P \rightarrow Q)) \rightarrow \neg P$

3 Subtyping Example 1

Provide a derivation for $X \vdash (X \rightarrow (\forall Y.Y)) <: (\bot \rightarrow X)$

4 Subtyping Example 2

Provide a derivation for $\vdash \forall X. (\forall Y.X \rightarrow Y) <: \forall Z.(Z \rightarrow \top)$

5 Individual Transitivity Case

Assume the last rules of the derivations of $\tau_1 <: \tau_2$ and $\tau_2 <: \tau_3$ were as follows:

$$
\begin{align*}
\vdash \tau_{21} <: \tau_{11} & \quad \vdash \tau_{12} <: \tau_{22} \\
\vdash \tau_{11} \rightarrow \tau_{12} & <: \tau_{21} \rightarrow \tau_{22}
\end{align*}
$$

$$
\begin{align*}
\vdash \tau_{31} <: \tau_{21} & \quad \vdash \tau_{22} <: \tau_{32} \\
\vdash \tau_{21} \rightarrow \tau_{22} & <: \tau_{31} \rightarrow \tau_{32}
\end{align*}
$$

Assuming transitivity holds on the subcomponents of the derivations, show that $\vdash \tau_{11} \rightarrow \tau_{12} <: \tau_{31} \rightarrow \tau_{32}$