$$
\begin{tikzcd}
c_1 = \langle X^*, \; Y \rangle \arrow[r, "\mathrm{Hom}_{\mathbf{C}}"] \arrow[d, "f"'] \arrow[d, phantom, "f_1^* \quad f_2"] & \mathrm{Hom}_{\mathbf{C}}(X; Y) \arrow[d, "\mathrm{Hom}_{\mathbf{C}}(g)"] \\
c_2 = \langle Z^*, \; U \rangle \arrow[r, "\mathrm{Hom}_{\mathbf{C}}"] & \mathrm{Hom}_{\mathbf{C}}(Z; U)
\end{tikzcd}
$$