

1

$$\begin{array}{c}
 \mathcal{E}_2 \quad \rho \vdash_{\Delta} \langle x, \sigma \rangle \longrightarrow_e \langle 3, \sigma \rangle \\
 \hline
 \mathcal{E}_3 \quad \rho \vdash_{\Delta} \langle x * y, \sigma \rangle \longrightarrow_e \langle 3 * y, \sigma \rangle \\
 \hline
 \mathcal{E}_1 \quad \rho \vdash_{\Delta} \langle x := x * y, \sigma \rangle \longrightarrow_c \langle x := 3 * y, \sigma \rangle
 \end{array}
 \quad
 \begin{array}{l}
 \rho(x) = \ell x \\
 \sigma(\ell x) = 3
 \end{array}$$

2

$$\begin{array}{c}
 \mathcal{E}_2 \quad \rho \vdash_{\Delta} \langle y, \sigma \rangle \longrightarrow_e \langle 2, \sigma \rangle \\
 \hline
 \mathcal{E}_4 \quad \rho \vdash_{\Delta} \langle 3 * y, \sigma \rangle \longrightarrow_e \langle 3 * 2, \sigma \rangle \\
 \hline
 \mathcal{E}_1 \quad \rho \vdash_{\Delta} \langle x := 3 * y, \sigma \rangle \longrightarrow_c \langle x := 3 * 2, \sigma \rangle
 \end{array}
 \quad
 \begin{array}{l}
 \rho(y) = 2
 \end{array}$$

3

$$\begin{array}{c}
 \mathcal{E}_1 \quad \rho \vdash_{\Delta} \langle 3 * 2, \sigma \rangle \longrightarrow_e \langle 6, \sigma \rangle \\
 \hline
 \mathcal{E}_1 \quad \rho \vdash_{\Delta} \langle x := 3 * 2, \sigma \rangle \longrightarrow_c \langle x := 6, \sigma \rangle
 \end{array}$$

4

$$\begin{array}{c}
 \mathcal{E}_2 \quad \rho \vdash_{\Delta} \langle x := 6, \sigma \rangle \longrightarrow_c \sigma[\ell x \leftarrow 6] \quad \rho(x) = \ell x
 \end{array}$$