

$$\begin{aligned}\llbracket \mathbf{T} \rrbracket &= \mathcal{P}(\mathbf{Val}) = \mathbf{Type} \\ \llbracket \mathbf{E} \rrbracket &= \llbracket \mathbf{R} \rrbracket = \mathcal{P}(\mathbf{Exp} \times \mathbb{N} \times \mathbf{Type}) = \mathbf{Eff}\end{aligned}$$

$$\mathbf{Obs} = \{e \mid \exists v. e \rightarrow^* v\}$$

$$\begin{aligned}\mathcal{E}[\tau/\rho]_\eta &= \{t \mid \forall K \in \mathcal{K}[\tau/\rho]_\eta. K[t] \in \mathbf{Obs}\} \\ \mathcal{K}[\tau/\rho]_\eta &= \{K \mid \forall v \in \llbracket \tau \rrbracket_\eta. K[v] \in \mathbf{Obs} \wedge \forall s \in \mathcal{S}[\tau/\rho]_\eta. K[s] \in \mathbf{Obs}\} \\ \mathcal{S}[\tau/\rho]_\eta &= \{K[\mathbf{do} v] \mid \exists n, \mu. (v, n, \mu) \in \llbracket \rho \rrbracket_\eta \wedge n\text{-free}(K) \wedge \forall e \in \mu. K[e] \in \mathcal{E}[\tau/\rho]_\eta\}\end{aligned}$$

$$\begin{aligned}\llbracket \tau_1 \rightarrow_\rho \tau_2 \rrbracket_\eta &= \{\lambda x. t \mid \forall v \in \llbracket \tau_1 \rrbracket_\eta. [x \mapsto v]t \in \mathcal{E}[\tau_2/\rho]_\eta\} \\ \llbracket \forall \alpha :: \kappa. \tau \rrbracket_\eta &= \{v \mid \forall \mu \in \llbracket \kappa \rrbracket_\eta. v \in \llbracket \tau \rrbracket_{[\alpha \mapsto \mu]_\eta}\} \\ \llbracket \alpha \rrbracket_\eta &= \eta(\alpha)\end{aligned}$$

$$\begin{aligned}\llbracket \tau_1 \Rightarrow \tau_2 \rrbracket_\eta &= \{(v, 0, \llbracket \tau_2 \rrbracket_\eta \mid v \in \llbracket \tau_1 \rrbracket_\eta)\} \\ \llbracket \forall \alpha :: \kappa. \varepsilon \rrbracket_\eta &= \{t \mid \exists \mu \in \llbracket \kappa \rrbracket_\eta. t \in \llbracket \varepsilon \rrbracket_{[\alpha \mapsto \mu]_\eta}\} \\ \llbracket \varepsilon \cdot \rho \rrbracket_\eta &= \llbracket \varepsilon \rrbracket_\eta \cup \{(v, n+1, \mu) \mid (v, n, \mu) \in \llbracket \rho \rrbracket_\eta\}\end{aligned}$$

$$\begin{aligned}\mathcal{E}[\tau/\rho]_\eta(\mathbf{X}) &= \{t \mid \forall K \in \mathcal{K}[\tau/\rho]_\eta(\mathbf{X}). K[t] \in \mathbf{Obs}\} \\ \mathcal{K}[\tau/\rho]_\eta(\mathbf{X}) &= \{K \mid \forall v \in \llbracket \tau \rrbracket_\eta. K[v] \in \mathbf{Obs} \wedge \forall s \in \mathcal{S}[\tau/\rho]_\eta(\mathbf{X}). K[s] \in \mathbf{Obs}\} \\ \mathcal{S}[\tau/\rho]_\eta(\mathbf{X}) &= \{K[\mathbf{do} v] \mid \exists n, \mu. (v, n, \mu) \in \llbracket \rho \rrbracket_\eta \wedge n\text{-free}(K) \wedge \forall e \in \mu. K[e] \in \mathbf{X}\}\end{aligned}$$

$$\begin{aligned}\mathcal{C}[\tau_1/\rho_1 \rightsquigarrow \tau_2/\rho_2]_\eta &= \{K \mid \forall v \in \llbracket \tau_1 \rrbracket_\eta. K[v] \in \mathcal{E}[\tau_2/\rho_2]_\eta \wedge \\ &\quad \forall e \in \mathcal{S}[\tau_1/\rho_1]_\eta. K[e] \in \mathcal{E}[\tau_2/\rho_2]_\eta\}\end{aligned}$$