$$
\begin{aligned}
\varsigma \in \Sigma &= \mathsf{Call} \times \mathit{BEnv} \times \mathit{VEnv} \times \mathit{Time} \\
\beta \in \mathit{BEnv} &= \mathsf{Var} \rightharpoonup \mathit{Bind} \\
\mathit{ve} \in \mathit{VEnv} &= \mathit{Bind} \rightharpoonup D \\
d \in D &= \mathit{Val} \\
\mathit{val} \in \mathit{Val} &= \mathit{Clo} \\
\mathit{clo} \in \mathit{Clo} &= \mathsf{Lam} \times \mathit{BEnv} \\
b \in \mathit{Bind} & \text{ is an } \textbf{infinite} \text{ set of bindings} \\
t \in \mathit{Time} & \text{ is an } \textbf{infinite} \text{ set of times}
\end{aligned}
\qquad
\begin{aligned}
\hat{\varsigma} \in \hat{\Sigma} &= \mathsf{Call} \times \widehat{\mathit{BEnv}} \times \widehat{\mathit{VEnv}} \times \widehat{\mathit{Time}} \\
\hat{\beta} \in \widehat{\mathit{BEnv}} &= \mathsf{Var} \rightharpoonup \widehat{\mathit{Bind}} \\
\widehat{\mathit{ve}} \in \widehat{\mathit{VEnv}} &= \widehat{\mathit{Bind}} \to \hat{D} \\
\hat{d} \in \hat{D} &= \mathcal{P}(\widehat{\mathit{Val}}) \\
\widehat{\mathit{val}} \in \widehat{\mathit{Val}} &= \widehat{\mathit{Clo}} \\
\widehat{\mathit{clo}} \in \widehat{\mathit{Clo}} &= \mathsf{Lam} \times \widehat{\mathit{BEnv}} \\
\hat{b} \in \widehat{\mathit{Bind}} & \text{ is a } \textbf{finite} \text{ set of bindings} \\
\hat{t} \in \widehat{\mathit{Time}} & \text{ is a } \textbf{finite} \text{ set of times}
\end{aligned}
$$

Fig. 1. State-space for the lambda calculus: Concrete (left) and abstract (right).

we can define the single concrete transition rule for CPS:

$$
\begin{aligned}
&([\![\mathtt{(}f\ e_1 \dots e_n\mathtt{)}^\ell]\!], \beta, \mathit{ve}, t) \Rightarrow (\mathit{call}, \beta'', \mathit{ve}', t'), \text{ where:} \\
&\qquad d_i = \mathcal{E}(e_i, \beta, \mathit{ve}) \\
&\qquad d_0 = ([\![\mathtt{(}\lambda^{\ell'}\ \mathtt{(}v_1 \dots v_n\mathtt{)}\ \mathit{call}\mathtt{)}]\!], \beta') \\
&\qquad t' = \mathit{tick}(\mathit{call}, t) \\
&\qquad b_i = \mathit{alloc}(v_i, t') \\
&\qquad \beta'' = \beta'[v_i \mapsto b_i] \\
&\qquad \mathit{ve}' = \mathit{ve}[b_i \mapsto d_i].
\end{aligned}
$$

With the help of an abstract evaluator, $\hat{\mathcal{E}} : \mathsf{Exp} \times \widehat{\mathit{BEnv}} \times \widehat{\mathit{VEnv}} \to \hat{D}$:

$$
\begin{aligned}
\hat{\mathcal{E}}\ (v, \hat{\beta}, \widehat{\mathit{ve}}) &= \widehat{\mathit{ve}}(\hat{\beta}(v)) \\
\hat{\mathcal{E}}\ (\mathit{lam}, \hat{\beta}, \widehat{\mathit{ve}}) &= \left\{(\mathit{lam}, \hat{\beta})\right\},
\end{aligned}
$$

we can define an analogous transition rule for the abstract semantics:

$$
\begin{aligned}
&([\![\mathtt{(}f\ e_1 \dots e_n\mathtt{)}^\ell]\!], \hat{\beta}, \widehat{\mathit{ve}}, \hat{t}) \leadsto (\mathit{call}, \hat{\beta}'', \widehat{\mathit{ve}}', \hat{t}'), \text{ where:} \\
&\qquad \hat{d}_i = \hat{\mathcal{E}}(e_i, \hat{\beta}, \widehat{\mathit{ve}}) \\
&\qquad \hat{d}_0 \ni ([\![\mathtt{(}\lambda^{\ell'}\ \mathtt{(}v_1 \dots v_n\mathtt{)}\ \mathit{call}\mathtt{)}]\!], \hat{\beta}') \\
&\qquad \hat{t}' = \widehat{\mathit{tick}}(\mathit{call}, \hat{t}) \\
&\qquad \hat{b}_i = \widehat{\mathit{alloc}}(v_i, \hat{t}') \\
&\qquad \hat{\beta}'' = \hat{\beta}'[v_i \mapsto \hat{b}_i] \\
&\qquad \widehat{\mathit{ve}}' = \widehat{\mathit{ve}} \sqcup [\hat{b}_i \mapsto \hat{d}_i].
\end{aligned}
$$