Perfectly Correlated

λ_{PC}

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Syntax

TODO

Static Semantics

TODO

Dynamic Semantic

Small-Step Semantics

$$\frac{\langle e,\, n,\, m\rangle \to \langle e',\, n',\, m'\rangle}{\langle E(e),\, n,\, m\rangle \to \langle E(e'),\, n',\, m'\rangle}\ \textsc{Context}$$

$$\frac{}{\langle \mathbf{rand}(),\, n,\, m\rangle \to \langle \mathbf{hd}\ m,\, n,\, \mathbf{tl}\ m\rangle}\ \textsc{Rand}$$

$$\frac{}{\langle (\lambda x : \tau.\, e)\, v,\, n,\, m\rangle \to \langle e\{v/x\},\, n,\, m\rangle}\ \beta\textsc{-Reduction}$$

$$\frac{}{\langle (\mathbf{case}\ \mathbf{inl}_{\tau_1+\tau_2} v\ \mathbf{of}\ e_2 \mid e_3),\, n,\, m\rangle \to \langle e_2\, v,\, n,\, m\rangle}\ \textsc{Case-Left}$$

$$\frac{}{\langle (\mathbf{case}\ \mathbf{inr}_{\tau_1+\tau_2} v\ \mathbf{of}\ e_2 \mid e_3),\, n,\, m\rangle \to \langle e_3\, v,\, n,\, m\rangle}\ \textsc{Case-Right}$$

$$\frac{}{\langle \mathbf{let}\ x = v\ \mathbf{in}\ e_2,\, n,\, m\rangle \to \langle e_2\{v/x\},\, n,\, m\rangle}\ \textsc{Let}$$

$$\frac{}{\langle \#\mathbf{1}\ (v_1, v_2),\, n,\, m\rangle \to \langle v_1,\, n,\, m\rangle}\ \textsc{Proj-1}$$

$$\frac{r_1 \bar{\oplus} r_2 = r}{\langle r_1 \oplus r_2,\, n,\, m\rangle \to \langle r,\, n,\, m\rangle}\ \textsc{Bop}$$

$$\frac{}{\langle \#\mathbf{2}\ (v_1, v_2),\, n,\, m\rangle \to \langle v_2,\, n,\, m\rangle}\ \textsc{Proj-2}$$

$$\frac{}{\langle \mathbf{coin}(),\, n,\, m\rangle \to \langle \mathbf{hd}\ n,\, \mathbf{tl}\ n,\, m\rangle}\ \textsc{Coin}$$

$$\frac{}{\langle e_1\ \mathbf{to}\ x\ \mathbf{in}\ e_2, n, m\rangle \to \langle e_2\{(\lambda y.\, e_1)\,()/x\}, n, m\rangle}\ \textsc{To-iid}$$

Big-Step Semantics

$$\frac{\langle e_1, n, m\rangle \Downarrow \langle \lambda x.\, e_1', n', m'\rangle \qquad \langle e_2, n', m'\rangle \Downarrow \langle v, n'', m''\rangle \qquad \langle e_1'\{v/x\}, n'', m''\rangle \Downarrow \langle v', n''', m'''\rangle}{\langle e_1\, e_2,\, n,\, m\rangle \Downarrow \langle v',\, n''',\, m'''\rangle}\ \beta\textsc{-Reduction}$$

$$\frac{\langle e_1, n, m\rangle \Downarrow \langle v, n', m'\rangle \qquad \langle e_2\{v/x\}, n', m'\rangle \Downarrow \langle v', n'', m''\rangle}{\langle \mathbf{let}\ x = e_1\ \mathbf{in}\ e_2,\, n,\, m\rangle \Downarrow \langle v',\, n'',\, m''\rangle}\ \textsc{Let}$$

$$\frac{\langle e_1, n, m\rangle \Downarrow \langle r_1, n', m'\rangle \qquad \langle e_2, n', m'\rangle \Downarrow \langle r_2, n'', m''\rangle \qquad r_1 \bar{\oplus} r_2 = r}{\langle e_1 \oplus e_2,\, n,\, m\rangle \Downarrow \langle r,\, n'',\, m''\rangle}\ \textsc{Bop}$$

$$\frac{}{\langle \mathbf{coin},\, n,\, m\rangle \Downarrow \langle \mathbf{hd}\ n,\, \mathbf{tl}\ n,\, m\rangle}\ \textsc{Coin}$$

$$\frac{}{\langle \mathbf{rand},\, n,\, m\rangle \Downarrow \langle \mathbf{hd}\ m,\, n,\, \mathbf{tl}\ m\rangle}\ \textsc{Rand}$$

$$\frac{\langle e_2\, e_1, n, m\rangle \Downarrow \langle v, n', m'\rangle}{\langle (\mathbf{case}\ \mathbf{inl}_{\tau_1+\tau_2} e_1\ \mathbf{of}\ e_2 \mid e_3),\, n,\, m\rangle \Downarrow \langle v,\, n',\, m'\rangle}\ \textsc{Case-Left}$$

$$\frac{\langle e_3\, e_1, n, m\rangle \Downarrow \langle v, n', m'\rangle}{\langle (\mathbf{case}\ \mathbf{inr}_{\tau_1+\tau_2} e_1\ \mathbf{of}\ e_2 \mid e_3),\ n,\ m\rangle \Downarrow \langle v,\ n',\ m'\rangle}\ \textsc{Case-Left}$$

$$\frac{\langle e_1, n, m\rangle \Downarrow \langle v, n', m'\rangle}{\langle \#\mathbf{1}\ (e_1, e_2),\ n,\ m\rangle \Downarrow \langle v, n', m'\rangle}\ \textsc{Proj-1}$$

$$\frac{\langle e_2, n, m\rangle \Downarrow \langle v, n', m'\rangle}{\langle \#\mathbf{2}\ (e_1, e_2),\ n,\ m\rangle \Downarrow \langle v, n', m'\rangle}\ \textsc{Proj-2}$$

$$\frac{\langle e_1, n, m\rangle \Downarrow \langle v, n', m''\rangle \qquad \langle e_2\{v/x\}, n', m'\rangle \Downarrow \langle v', n'', m''\rangle}{\langle e_1\ \mathbf{to}\ x\ \mathbf{in}\ e_2, n, m\rangle \Downarrow \langle v, n'', m''\rangle}\ \textsc{To-iid}$$

Denotational Semantics

$$\begin{aligned}
[\![r]\!] &\triangleq \delta_r \\
[\![\lambda x.\, e]\!] &\triangleq \\
[\![\mathbf{coin}]\!] &\triangleq \\
[\![e_1\ e_2]\!] &\triangleq
\end{aligned}$$

Translation to CBPV

$$\begin{aligned}
\mathcal{T}[\![x]\!] &\triangleq \mathbf{produce}\ x \\
\mathcal{T}[\![\lambda x.\, e]\!] &\triangleq \mathbf{produce\ thunk}\ \lambda x.\, [\![e]\!] \\
\mathcal{T}[\![\mathbf{let} x = e_1\ \mathbf{in}\ e_2]\!] &\triangleq \mathcal{T}[\![e_1]\!]\ \mathbf{to}\ x.\, \mathcal{T}[\![e_2]\!] \\
\mathcal{T}[\![e_1\, e_2]\!] &\triangleq \mathcal{T}[\![e_2]\!]\ \mathbf{to}\ x.\, \mathcal{T}[\![e_1]\!]\ \mathbf{to}\ f.\, x`(\mathbf{force}\ f) \\
\mathcal{T}[\![\mathbf{coin}]\!] &\triangleq \\
\mathcal{T}[\![\mathbf{rand}]\!] &\triangleq \\
\mathcal{T}[\![\mathbf{inl}_{\tau_1+\tau_2} e]\!] &\triangleq \mathcal{T}[\![e]\!]\ \mathbf{to}\ z.\, \mathbf{produce\ inl}\ z \\
\mathcal{T}[\![\mathbf{inr}_{\tau_1+\tau_2} e]\!] &\triangleq \mathcal{T}[\![e]\!]\ \mathbf{to}\ z.\, \mathbf{produce\ inr}\ z \\
\mathcal{T}[\![\mathbf{case}\ e_1 \mathbf{of}\ e_2 | e_3]\!] &\triangleq \\
\mathcal{T}[\![(e_1, e_2)]\!] &\triangleq \\
\mathcal{T}[\![\#\mathbf{1}\ e]\!] &\triangleq \\
\mathcal{T}[\![\#\mathbf{2}\ e]\!] &\triangleq \\
\mathcal{T}[\![e_1\ \mathbf{to}\ x\ \mathbf{in}\ e2]\!] &\triangleq
\end{aligned}$$