Impcore Semantics

All values are integers. State $\langle e, \xi, \phi, \rho \rangle$ is

e	Expression being evaluated
ξ	Values of global variables
ϕ	Definitions of functions
ρ	Values of formal parameters

Expression evaluation. Rules form a proof system for judgment:

$$\langle e, \xi, \phi, \rho \rangle \Downarrow \langle v, \xi', \phi, \rho' \rangle$$

$$\frac{}{\langle \textsc{literal}(v), \xi, \phi, \rho \rangle \Downarrow \langle v, \xi, \phi, \rho \rangle} \quad (\textsc{Literal})$$

$$\frac{x \in \operatorname{dom} \rho}{\langle \textsc{var}(x), \xi, \phi, \rho \rangle \Downarrow \langle \rho(x), \xi, \phi, \rho \rangle} \quad (\textsc{FormalVar})$$

$$\frac{x \notin \operatorname{dom} \rho \qquad x \in \operatorname{dom} \xi}{\langle \textsc{var}(x), \xi, \phi, \rho \rangle \Downarrow \langle \xi(x), \xi, \phi, \rho \rangle} \quad (\textsc{GlobalVar})$$

$$\frac{x \in \operatorname{dom} \rho \qquad \langle e, \xi, \phi, \rho \rangle \Downarrow \langle v, \xi', \phi, \rho' \rangle}{\langle \textsc{set}(x, e), \xi, \phi, \rho \rangle \Downarrow \langle v, \xi', \phi, \rho'\{x \mapsto v\} \rangle} \quad (\textsc{FormalAssign})$$

$$\frac{x \notin \operatorname{dom} \rho \qquad x \in \operatorname{dom} \xi \qquad \langle e, \xi, \phi, \rho \rangle \Downarrow \langle v, \xi', \phi, \rho' \rangle}{\langle \textsc{set}(x, e), \xi, \phi, \rho \rangle \Downarrow \langle v, \xi'\{x \mapsto v\}, \phi, \rho \rangle} \quad (\textsc{GlobalAssign})$$

$$\frac{\langle e_1, \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle \qquad v_1 \neq 0 \qquad \langle e_2, \xi', \phi, \rho' \rangle \Downarrow \langle v_2, \xi'', \phi, \rho'' \rangle}{\langle \textsc{if}(e_1, e_2, e_3), \xi, \phi, \rho \rangle \Downarrow \langle v_2, \xi'', \phi, \rho'' \rangle} \quad (\textsc{IfTrue})$$

$$\frac{\langle e_1, \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle \qquad v_1 = 0 \qquad \langle e_3, \xi', \phi, \rho' \rangle \Downarrow \langle v_2, \xi'', \phi, \rho'' \rangle}{\langle \textsc{if}(e_1, e_2, e_3), \xi, \phi, \rho \rangle \Downarrow \langle v_2, \xi'', \phi, \rho'' \rangle} \quad (\textsc{IfFalse})$$

$$\frac{\begin{array}{c}\langle e_1, \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle \qquad v_1 \neq 0 \qquad \langle e_2, \xi', \phi, \rho' \rangle \Downarrow \langle v_2, \xi'', \phi, \rho'' \rangle \\ \langle \textsc{while}(e_1, e_2), \xi'', \phi, \rho'' \rangle \Downarrow \langle v_3, \xi''', \phi, \rho''' \rangle\end{array}}{\langle \textsc{while}(e_1, e_2), \xi, \phi, \rho \rangle \Downarrow \langle v_3, \xi''', \phi, \rho''' \rangle} \quad (\textsc{WhileIterate})$$

$$\frac{\langle e_1, \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle \qquad v_1 = 0}{\langle \textsc{while}(e_1, e_2), \xi, \phi, \rho \rangle \Downarrow \langle 0, \xi', \phi, \rho' \rangle} \quad (\textsc{WhileEnd})$$

$$\frac{}{\langle \textsc{begin}(), \xi, \phi, \rho \rangle \Downarrow \langle 0, \xi, \phi, \rho \rangle} \quad (\textsc{EmptyBegin})$$

$$\frac{\begin{array}{c}\langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi_1, \phi, \rho_1\rangle \\ \dots \\ \langle e_n, \xi_{n-1}, \phi, \rho_{n-1}\rangle \Downarrow \langle v_n, \xi_n, \phi, \rho_n\rangle\end{array}}{\langle \text{BEGIN}(e_1, ..., e_n), \xi, \phi, \rho\rangle \Downarrow \langle v_n, \xi_n, \phi, \rho_n\rangle} \quad \text{(Begin)}$$

$$\frac{\begin{array}{c}\phi(f) = \text{USER}(\langle x_1, \dots, x_n\rangle, e) \\ \langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi_1, \phi, \rho_1\rangle \\ \vdots \\ \langle e_n, \xi_{n-1}, \phi, \rho_{n-1}\rangle \Downarrow \langle v_n, \xi_n, \phi, \rho_n\rangle \\ \langle e, \xi_n, \phi, \{x_1 \mapsto v_1, \dots, x_n \mapsto v_n\}\rangle \Downarrow \langle v, \xi', \phi, \rho'\rangle\end{array}}{\langle \text{APPLY}(f, e_1, \dots, e_n), \xi, \phi, \rho\rangle \Downarrow \langle v, \xi', \phi, \rho_n\rangle} \quad \text{(ApplyUser)}$$

$$\frac{\begin{array}{c}\phi(f) = \text{PRIMITIVE}(\texttt{+}) \\ \langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi_1, \phi, \rho_1\rangle \\ \langle e_2, \xi_1, \phi, \rho_1\rangle \Downarrow \langle v_2, \xi_2, \phi, \rho_2\rangle\end{array}}{\langle \text{APPLY}(f, e_1, e_2), \Downarrow, \langle, , v_{,}\, 1\rangle + v_2\rangle \xi_2 \phi \rho_2} \quad \text{(ApplyPlus)}$$

$$\frac{\begin{array}{c}\phi(f) = \text{PRIMITIVE}(\texttt{=}) \\ \langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi_1, \phi, \rho_1\rangle \\ \langle e_2, \xi_1, \phi, \rho_1\rangle \Downarrow \langle v_2, \xi_2, \phi, \rho_2\rangle v_1 = v_2 \\ <\end{array}}{\langle \text{APPLY}(f, e_1, e_2), \Downarrow, \langle, , 1, \rangle, \xi_2\rangle \phi \rho_2} \quad \text{(ApplyEqualTrue)}$$

$$\frac{\begin{array}{c}\phi(f) = \text{PRIMITIVE}(\texttt{=}) \\ \langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi_1, \phi, \rho_1\rangle \\ \langle e_2, \xi_1, \phi, \rho_1\rangle \Downarrow \langle v_2, \xi_2, \phi, \rho_2\rangle \\ v_1 \neq v_2\end{array}}{\langle \text{APPLY}(f, e_1, e_2), \Downarrow, \langle, , 0, \rangle, \xi_2\rangle \phi \rho_2} \quad \text{(ApplyEqualFalse)}$$

Top-level transitions

$$\frac{\langle e, \xi, \phi, \{\}\rangle \Downarrow \langle v, \xi', \phi, \rho'\rangle}{\langle \exp(e), \xi, \phi\rangle \to \langle \xi', \phi\rangle} \quad \text{(EvalExp)}$$

$$\frac{\langle e, \xi, \phi, \{\}\rangle \Downarrow \langle v, \xi', \phi, \rho'\rangle}{\langle \text{VAL}(x, e), \xi, \phi\rangle \to \langle \xi'\{x \mapsto v\}, \phi\rangle} \quad \text{(DefineGlobal)}$$

$$\frac{}{\langle \text{USER}(f, \langle x_1, \dots, x_n\rangle, e), \xi, \phi\rangle \to \langle \xi, \phi\{f \mapsto \text{USER}(\langle x_1, \dots, x_n\rangle e)\rangle} \quad \text{(DefineFunction)}$$