

- Denotation for each typing relation derivation

- - (Unit) $\frac{}{\llbracket \Gamma \vdash () : \mathbf{Unit} \rrbracket_M = \llbracket () \rrbracket_M \circ \langle \rangle_\Gamma : \Gamma \rightarrow \llbracket \mathbf{Unit} \rrbracket_M}$
 - (Const) $\frac{}{\llbracket \Gamma \vdash \mathbf{C}^A : A \rrbracket_M = \llbracket \mathbf{C}^A \rrbracket_M \circ \langle \rangle_\Gamma : \Gamma \rightarrow \llbracket A \rrbracket_M}$
 - (True) $\frac{}{\llbracket \Gamma \vdash \mathbf{true} : \mathbf{Bool} \rrbracket_M = \llbracket \mathbf{true} \rrbracket_M \circ \langle \rangle_\Gamma : \Gamma \rightarrow \llbracket \mathbf{Bool} \rrbracket_M}$
 - (False) $\frac{}{\llbracket \Gamma \vdash \mathbf{false} : \mathbf{Bool} \rrbracket_M = \llbracket \mathbf{false} \rrbracket_M \circ \langle \rangle_\Gamma : \Gamma \rightarrow \llbracket \mathbf{Bool} \rrbracket_M}$
 - (Lambda) $\frac{f = \llbracket \Gamma, x : A \rrbracket_M C \mathbf{M}_\epsilon B : \Gamma \times A \rightarrow T_\epsilon B}{\llbracket \Gamma \vdash \lambda x : A. C : A \rightarrow \mathbf{M}_\epsilon B \rrbracket_M = \mathbf{cur}(f) : \Gamma \rightarrow (T_\epsilon B)^A}$
 - (Return) $\frac{f = \llbracket \Gamma \vdash v : A \rrbracket_M}{\llbracket \Gamma \vdash \mathbf{return} v : \mathbf{M}_1 A \rrbracket_M = \eta_A \circ f}$
 - (Subtype) $\frac{f = \llbracket \Gamma \vdash v : A \rrbracket_M : \Gamma \rightarrow Ag = \llbracket A \leq : B \rrbracket_M}{\llbracket \Gamma \vdash v : B \rrbracket_M = g \circ f : \Gamma \rightarrow B}$
 - (Subeffect) $\frac{f = \llbracket \Gamma \vdash c : \mathbf{M}_{\epsilon_1} A \rrbracket_M : \Gamma \rightarrow T_{\epsilon_1} Ag = \llbracket A \leq : B \rrbracket_M h = \llbracket \epsilon_1 \leq \epsilon_2 \rrbracket_M}{\llbracket \Gamma \vdash C : \mathbf{M}_{\epsilon_2} B \rrbracket_M = h_B \circ T_{\epsilon_1} g \circ f}$
 - (If) $\frac{f = \llbracket \Gamma \vdash v : \mathbf{Bool} \rrbracket_M g = \llbracket \Gamma \vdash C_1 : \mathbf{M}_\epsilon A \rrbracket_M h = \llbracket \Gamma \vdash C_2 : \mathbf{M}_\epsilon A \rrbracket_M}{\llbracket \Gamma \vdash \mathbf{if}_{\epsilon, A} v \mathbf{then}_{C_1} \mathbf{else}_{C_2} \mathbf{M}_\epsilon A \rrbracket_M = \mathbf{if}_{\epsilon, A} \circ \langle f, \langle g, h \rangle \rangle : \Gamma \rightarrow T_\epsilon A}$
 - (Bind) $\frac{f = \llbracket \Gamma \vdash C_1 : \mathbf{M}_{\epsilon_1} A : \Gamma \rightarrow T_{\epsilon_1} Ag = \llbracket \Gamma, x : A \vdash C_2 : \mathbf{M}_{\epsilon_2} B \rrbracket_M : \Gamma \times A \rightarrow T_{\epsilon_2} B}{\llbracket \Gamma \vdash \mathbf{do} x \leftarrow C_1 \mathbf{in} C_2 : \mathbf{M}_{\epsilon_1 \cdot \epsilon_2} B \rrbracket_M = \mu_{\epsilon_1, \epsilon_2, B} \circ T_{\epsilon_1} g \circ \mathbf{t}_{\Gamma, A, \epsilon_1} \circ \langle \mathbf{Id}_\Gamma, f \rangle : \Gamma \rightarrow T_{\epsilon_1 \cdot \epsilon_2} B}$

- Denotations of Types

- Denotations of subtyping and subeffecting