

$\text{termvar}, x, y, d$	Term-level variable	
label, l	$::=$	Label
mode, m	$::=$ $-$ L F G $\text{max_mode}(\Gamma)$	Mode Placeholder for any mode Local Foreign Global
type, A, B	$::=$ 1 $A_1 \oplus A_2$ $A_1 \otimes A_2$ $A_1 \multimap_{m_1} A_2$ $A_1 \multimap_{m_2} A_2$ A^\perp (A)	Type Unit Sum Product Ampar type (consuming A_1 yields A_2) Linear function Destination S
$\text{dynamic_value}, v$	$::=$ l $@l$ $()$ $\text{Inl } v$ $\text{Inr } v$ $\langle v_1, v_2 \rangle$ $\langle v_1, v_2 \rangle$ $\lambda x. t$ (v)	Dynamic value Hole Destination Unit Left variant for sum Right variant for sum Product Ampar (v_2 is the root of the structure) Linear function S
term, t, u	$::=$ v x $t \ u$ $t ; u$ $\text{case } t \text{ of } \{ \text{Inl } x_1 \mapsto u_1, \text{Inr } x_2 \mapsto u_2 \}$ $\text{case } t \text{ of } \{ \langle x_1, x_2 \rangle \mapsto u \}$ $\text{mapL } t \text{ with } \{ x \mapsto u \}$ to_G from_G to_\times from_\times alloc $t \triangleleft ()$ $t \triangleleft \text{Inl}$ $t \triangleleft \text{Inr}$ $t \triangleleft \langle, \rangle$ $t \triangleleft \cdot u$ (t) $t[e]$	Term Dynamic value Variable Application Pattern-match on unit Pattern-match on sum Pattern-match on product Map over the left side of the ampar Mode coercion to G Mode coercion from G Wrap t into a trivial ampar Extract value from trivial ampar Return a fresh "identity" ampar object Fill destination with unit Fill destination with left variant Fill destination with right variant Fill destination with product constructor Fill destination with root of ampar object S M

sub	$::=$ $\mid x \mapsto v$	variable or label substitution
subs	$::=$ $\mid \text{sub}$ $\mid \text{sub}, \text{subs}$	variable or substitutions
effect, e	$::=$ $\mid \varepsilon$ $\mid \text{subs}$	empty effect
type_affect, ta	$::=$ $\mid x :_m A$ $\mid +l : A$ $\mid -l : A$	type affectation Hole Destination
type_affects	$::=$ $\mid \text{ta}$ $\mid \text{ta}, \text{type_affects}$	type affectations
typing_context, \mathcal{U}, Γ	$::=$ $\mid \{\}$ $\mid \{\text{type_affects}\}$ $\mid \Gamma_1 \sqcup \Gamma_2$ $\mid \Gamma_1 \sqcup \Gamma_2$ $\mid \Gamma[m_1 \mapsto m_2]$	typing context
terminals	$::=$ $\mid \text{---}\circ$ $\mid \times$ $\mid \mapsto$ $\mid ()$ $\mid \text{Inl}$ $\mid \text{Inr}$ $\mid \langle, \rangle$ $\mid \odot$ $\mid \triangleleft$ $\mid \triangleleft\cdot$ $\mid ;$ $\mid \sqcup$ $\mid \sqcup$ $\mid \{\}$ $\mid \neq$ $\mid \leq$ $\mid \in$ $\mid \notin$ $\mid \subset$ $\mid \mathcal{N}$ $\mid \vdash$	

	$\mid \longrightarrow$ $\mid \rightsquigarrow$
formula	$::=$ \mid judgement
Ctx	$::=$ $\mid x \in \mathcal{N}(\Gamma)$ $\mid l \in \mathcal{N}(\Gamma)$ $\mid x \notin \mathcal{N}(\Gamma)$ $\mid l \notin \mathcal{N}(\Gamma)$ $\mid \text{fresh } x$ $\mid \text{fresh } l$ $\mid \text{type_affect} \in \Gamma$ $\mid \text{comparable_modes}(\Gamma)$
Eq	$::=$ $\mid A_1 = A_2$ $\mid A_1 \neq A_2$ $\mid t = u$ $\mid t \neq u$ $\mid m_1 = m_2$ $\mid m_1 \leq m_2$ $\mid \Gamma_1 = \Gamma_2$ $\mid \mathcal{N}(\Gamma_1) \cap \mathcal{N}(\Gamma_2) = \emptyset$
Ty	$::=$ $\mid \Gamma \vdash t :_{\text{m}} A$
judgement	$::=$ \mid Ctx \mid Eq \mid Ty
user_syntax	$::=$ \mid termvar \mid label \mid mode \mid type \mid dynamic_value \mid term \mid sub \mid subs \mid effect \mid type_affect \mid type_affects \mid typing_context \mid terminals

$$x \in \mathcal{N}(\Gamma)$$

$l \in \mathcal{N}(\Gamma)$
$x \notin \mathcal{N}(\Gamma)$
$l \notin \mathcal{N}(\Gamma)$
fresh x
fresh l
$\text{type_affect} \in \Gamma$
$\text{comparable_modes}(\Gamma)$
$A_1 = A_2$
$A_1 \neq A_2$
$t = u$
$t \neq u$
$m_1 = m_2$
$m_1 \leq m_2$
$\Gamma_1 = \Gamma_2$
$\mathcal{N}(\Gamma_1) \cap \mathcal{N}(\Gamma_2) = \emptyset$
$\Gamma \vdash t :_m A$

$\frac{\Gamma \vdash t :_G A}{\Gamma \vdash \text{from}_G :_m A}$	$\text{TyTERM_WEAKENLOCAL}$
$\frac{\begin{array}{l} G = \text{max_mode}(\Gamma) \\ \Gamma \vdash t :_m A \end{array}}{\Gamma \vdash \text{to}_G :_G A}$	$\text{TyTERM_WEAKENFOREIGN}$
$\frac{}{\overline{\{+l : A\} \vdash l :_m A}}$	TyTERM_HOLE
$\frac{}{\overline{\{-l : A\} \vdash @l :_m A^\perp}}$	TyTERM_DEST
$\frac{}{\overline{\{\} \vdash () :_G 1}}$	TyTERM_UNIT
$\frac{\Gamma \vdash v :_m A_1}{\Gamma \vdash \text{Inl } v :_m A_1 \oplus A_2}$	TyTERM_INL
$\frac{\Gamma \vdash v :_m A_2}{\Gamma \vdash \text{Inr } v :_m A_1 \oplus A_2}$	TyTERM_INR
$\frac{\Gamma_1 \vdash v_1 :_m A_1 \quad \Gamma_2 \vdash v_2 :_m A_2}{\Gamma_1 \sqcup \Gamma_2 \vdash \langle v_1, v_2 \rangle :_m A_1 \otimes A_2}$	TyTERM_PROD
$\frac{\Gamma_1 \vdash v_1 :_m A_1 \quad \Gamma_2 \vdash v_2 :_m A_2 \quad \Gamma_3 = \Gamma_1 \uplus \Gamma_2}{\Gamma_3 \vdash \langle v_1, v_2 \rangle :_{m_2} A_1 \times A_2}$	TyTERM_AMPAR
$\frac{\begin{array}{l} \Gamma \sqcup \{x :_{m_1} A_1\} \vdash t :_{m_2} A_2 \\ \text{comparable_modes}(\Gamma \sqcup \{x :_{m_1} A_1\}) \\ m_1 = \text{max_mode}(\Gamma \sqcup \{x :_{m_1} A_1\}) \end{array}}{\Gamma \vdash \lambda x. t :_{m_1} A_1 \multimap_{m_2} A_2}$	TyTERM_LAMBDA

$$\begin{array}{c}
\frac{\Gamma_1 \vdash t :_{\mathbf{m}_1} A_1 \multimap_{\mathbf{m}_2} A_2 \quad \Gamma_2 \vdash u :_{\mathbf{m}_1} A_1}{\Gamma_1 \sqcup \Gamma_2 \vdash tu :_{\mathbf{m}_2} A_2} \text{TYTERM_APP} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{m}} 1 \quad \Gamma_2 \vdash u :_{\mathbf{m}'} B}{\Gamma_1 \sqcup \Gamma_2 \vdash t ; u :_{\mathbf{m}'} B} \text{TYTERM_PATUNIT} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{m}} A_1 \oplus A_2 \quad \Gamma_2 \sqcup \{x_1 :_{\mathbf{m}} A_1\} \vdash u_1 :_{\mathbf{m}'} B \quad \Gamma_2 \sqcup \{x_2 :_{\mathbf{m}} A_2\} \vdash u_2 :_{\mathbf{m}'} B}{\Gamma_1 \sqcup \Gamma_2 \vdash \text{case } t \text{ of } \{ \text{Inl } x_1 \mapsto u_1, \text{Inr } x_2 \mapsto u_2 \} :_{\mathbf{m}'} B} \text{TYTERM_PATSUM} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{m}} A_1 \otimes A_2 \quad \Gamma_2 \sqcup \{x_1 :_{\mathbf{m}} A_1, x_2 :_{\mathbf{m}} A_2\} \vdash u :_{\mathbf{m}'} B}{\Gamma_1 \sqcup \Gamma_2 \vdash \text{case } t \text{ of } \{ \langle x_1, x_2 \rangle \mapsto u \} :_{\mathbf{m}'} B} \text{TYTERM_PATPROD} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{m}_2} A_1 \mathbin{\text{m}_1} A_2 \quad \text{comparable_modes}(\Gamma_1 \sqcup \Gamma_2) \quad \mathbf{m}'_2 = \text{max_mode}(\Gamma_1 \sqcup \Gamma_2) \quad \Gamma_2[\mathbf{L} \mapsto \mathbf{F}] \sqcup \{x :_{\mathbf{m}_1} A_1\} \vdash u :_{\mathbf{m}'_1} A'_1}{\Gamma_1 \sqcup \Gamma_2 \vdash \text{mapL } t \text{ with } \{x \mapsto u\} :_{\mathbf{m}'_2} A'_1 \mathbin{\text{m}'_1} A_2} \text{TYTERM_MAPAMPAR} \\
\\
\frac{}{\{\} \vdash \text{alloc} :_{\mathbf{G}} (A_2^\perp)_{\mathbf{L}} \mathbin{\text{L}} A_2} \text{TYTERM_ALLOC} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} A}{\Gamma \vdash \text{to}_{\mathbin{\text{L}}} :_{\mathbf{m}} 1_{\mathbf{G}} \mathbin{\text{L}} A} \text{TYTERM_TOAMPAR} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} 1_{\mathbin{\text{L}}} \mathbin{\text{L}} A}{\Gamma \vdash \text{from}_{\mathbin{\text{L}}} :_{\mathbf{m}} A} \text{TYTERM_FROMAMPAR} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} 1^\perp}{\Gamma \vdash t \triangleleft () :_{\mathbf{G}} 1} \text{TYTERM_FILLUNIT} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} (A_1 \oplus A_2)^\perp}{\Gamma \vdash t \triangleleft \text{Inl} :_{\mathbf{m}} A_1^\perp} \text{TYTERM_FILLINL} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} (A_1 \oplus A_2)^\perp}{\Gamma \vdash t \triangleleft \text{Inr} :_{\mathbf{m}} A_2^\perp} \text{TYTERM_FILLINR} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} (A_1 \otimes A_2)^\perp}{\Gamma \vdash t \triangleleft \langle, \rangle :_{\mathbf{m}} A_1^\perp \otimes A_2^\perp} \text{TYTERM_FILLPROD} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{L}} A_2^\perp \quad \Gamma_2 \vdash u :_{\mathbf{m}_2} A_1 \mathbin{\text{m}_1} A_2 \quad \mathbf{m}_2 \leq \mathbf{F}}{\Gamma_1 \sqcup \Gamma_2 \vdash t \triangleleft \cdot u :_{\mathbf{m}_1} A_1} \text{TYTERM_FILLCOMPL} \\
\\
\frac{\Gamma_1 \vdash t :_{\mathbf{F}} A_2^\perp \quad \Gamma_2 \vdash u :_{\mathbf{G}} A_1 \mathbin{\text{m}_1} A_2}{\Gamma_1 \sqcup \Gamma_2 \vdash t \triangleleft \cdot u :_{\mathbf{m}_1} A_1} \text{TYTERM_FILLCOMPF}
\end{array}$$

Definition rules: 24 good 0 bad

Definition rule clauses: 61 good 0 bad