

termvar, x, y, h

label, l

::=

mode, m

::=

$-$
 L
 F
 G
 $\text{max_mode}(\Gamma)$

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

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	$::=$ $\mid \text{Ctx}$ $\mid \text{Eq}$ $\mid \text{Ty}$
user_syntax	$::=$ $\mid \text{termvar}$ $\mid \text{label}$ $\mid \text{mode}$ $\mid \text{type}$ $\mid \text{dynamic_value}$ $\mid \text{term}$ $\mid \text{sub}$ $\mid \text{subs}$ $\mid \text{effect}$ $\mid \text{type_affect}$ $\mid \text{type_affects}$ $\mid \text{typing_context}$ $\mid \text{terminals}$

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

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

$\frac{\Gamma \vdash t :_G A}{\Gamma \vdash \text{from}_G :_m A}$	$\text{TyTERM_WEAKENLOCAL}$
$\frac{\begin{array}{c} G = \text{max_mode}(\Gamma) \\ \Gamma \vdash t :_m A \end{array}}{\Gamma \vdash \text{to}_G :_G A}$	$\text{TyTERM_WEAKENFOREIGN}$
$\frac{}{\{\textcolor{brown}{+}l : A\} \vdash \textcolor{brown}{l} :_m A}$	TyTERM_HOLE
$\frac{}{\{\textcolor{brown}{-}l : A\} \vdash \textcolor{brown}{@}l :_m A^\perp}$	TyTERM_DEST
$\frac{}{\{\} \vdash () :_G 1}$	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
$\frac{\begin{array}{c} \Gamma \sqcup \{x :_{m_1} A_1\} \vdash t :_{m_2} A_2 \\ \text{comparable_modes}(\Gamma \sqcup \{x :_{m_1} A_1\}) \\ m_1 = \text{max_mode}(\Gamma \sqcup \{x :_{m_1} A_1\}) \end{array}}{\Gamma \vdash \lambda x. t :_{m_1} A_1 \multimap_{m_2} A_2}$	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{\mathbb{M}}_{\mathbf{m}_1} A_2 \quad \text{comparable_modes}(\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{\mathbb{M}}_{\mathbf{m}'_1} A_2} \text{TYTERM_MAPAMPAR} \\
\\
\frac{}{\{\} \vdash \text{alloc} :_{\mathbf{G}} (A_2^\perp)_{\mathbf{L}} \mathbin{\mathbb{M}} A_2} \text{TYTERM_ALLOC} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} A}{\Gamma \vdash \text{to}_{\mathbb{M}} :_{\mathbf{m}} 1_{\mathbf{G}} \mathbin{\mathbb{M}} A} \text{TYTERM_TOAMPAR} \\
\\
\frac{\Gamma \vdash t :_{\mathbf{m}} 1_{\mathbb{M}} \mathbin{\mathbb{M}} A}{\Gamma \vdash \text{from}_{\mathbb{M}} :_{\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{\mathbb{M}}_{\mathbf{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{\mathbb{M}}_{\mathbf{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