As of now, this document is mostly for myself. Its missing a lot of prose and explantions (and may eventually be discarded).

Contents

1 Introduction

All valid terms have a type who's type is of the form $*$.

All valid types have a type who's type is of the form of either $\square^{\sigma}$. where σ is a Unification.

Variables in the type environment are annotated with their multiplicity. ie $x :^{1}$ ....

Function literals are syntactically required to be top level only. Top level function types are internal.

Overlines are used to mean 0 or more.

After β reduction, terms not of type σ^π must either be a free variable or correspond to these β normal forms.

Type	Term
$\sigma \xrightarrow[\pi]{\uparrow} \tau$	$\lambda x.e$
$\forall \alpha : \kappa.\sigma$	$\Lambda \alpha.e$
$\sigma \xrightarrow{\text{text}} \tau$	function$(x).e$

Some types use synatatic unificition, others use boolean unification (denoted by their kind). Types which use boolean unification all permit the standard boolean operations(`true`, `false`, $\wedge$, $\vee$, etc).

2 Object Categories

e	(Terms)
x	(Variables)
$\sigma, \tau, \pi, \kappa, \rho$	(Types)
α, β	(Type Variables)
Γ	(Type Environment)
Φ	(Misc Environment)

2.0.1 Misc Categories

n	(Numbers)
sym	(Symbol)
c	(Erasure)
$c ::=$	
$\circ$	(Transparent)
$\bullet$	(Concrete)

3 Judgment Forms

The term rules are not syntax directed. The type of a term must be a valid type ($\Phi|\Gamma \vdash e : \sigma$, requires $\Phi \vdash \sigma : \kappa$).

$$\Phi \mid \Gamma \vdash e : \sigma \qquad \text{(Term Validation)}$$
$$\Phi \vdash \sigma : \kappa \qquad \text{(Type Validation)}$$
$$\Phi \Vdash^{c} \sigma \qquad \text{(Erasure Entailment)}$$

4 Synonyms

Synonyms for true / false in boolean unification.

Syntax	Synonym
1	`false`
ω	`true`
`pure`	`false`

5 Typing Environments

$$\begin{aligned}
\Gamma ::= & \\
& \Gamma, x :^{\pi} \sigma \\
& \varnothing \\
\Phi ::= & \\
& \Phi, \alpha :^{c} \kappa \\
& \varnothing
\end{aligned}$$

Type environments can be multiplied by a multiplicity, following from Linear Haskell. Except due to the representation of multiplicity as booleans, multiplication gets mapped to disjunction.

$$\pi\Gamma = \{(x :^{\pi \vee \pi'}) \mid (x :^{\pi'}) \in \Gamma\}$$
$$\Gamma, \Gamma' = (\Gamma \oplus \Gamma') \cup \{(x^{\omega}) \mid (x :^{\pi}) \in \Gamma, (x :^{\pi'}) \in \Gamma'\}$$

6 Meta

Multiplicity uses boolean unification where ω (`true`) is unrestricted and 1 (`false`) is linear.

$$\sigma, \tau, \pi, \kappa, \rho ::=$$

$$
\begin{array}{rl}
* & \text{(Type)} \\
\square^{\sigma} & \text{(Kind)} \\
\top & \text{(Top)} \\
\text{Syntactic} & \\
\text{Propositional} & \\
\text{Unification} & \\
\text{Multiplicity} & \\
\text{Label} &
\end{array}
$$

$$\frac{}{\Phi \vdash * : \square^{\text{Syntactic}}}$$

$$\frac{\Phi \vdash \sigma : \text{Unification}}{\Phi \vdash \square^{\sigma} : \top}$$

$$\frac{}{\Phi \vdash \text{Syntactic} : \text{Unification}}$$

$$\frac{}{\Phi \vdash \text{Propositional} : \text{Unification}}$$

$$\frac{}{\Phi \vdash \text{Unification} : \top}$$

$$\frac{}{\Phi \vdash \text{Multiplicity} : \square^{\text{Propositional}}}$$

$$\frac{}{\Phi \vdash \text{Label} : \top}$$

6.1 Variables

$$
\begin{array}{rll}
e ::= & & \\
 & x & \text{(Variable)} \\
 & \dots & \\
\sigma, \tau, \pi, \kappa, \rho ::= & & \\
 & \alpha & \text{(Type Variable)} \\
 & \dots &
\end{array}
$$

$$\frac{}{\Phi \,|\, \omega(\Gamma \backslash \{x :^{\pi} \sigma\}), x :^{\pi} \sigma \vdash x : \sigma}$$

$$\frac{(\alpha : \kappa) \in \Phi}{\Phi \vdash \alpha : \kappa}$$

6.2 Macro Linear Lambda Calculus

$$\begin{array}{rll} e ::= & & \\ & \lambda^{\uparrow} x.e & \text{(Macro Lambda)} \\ & e(^{\uparrow} e') & \text{(Macro Application)} \\ & \cdots & \\ \sigma, \tau, \pi, \kappa, \rho ::= & & \\ & \sigma \xrightarrow{\uparrow}_{\pi} \tau & \text{(Macro)} \\ & \cdots & \\ \cdots & & \end{array}$$

$$\frac{\Phi | \Gamma, x :^{\pi} \sigma \vdash e : \tau}{\Phi | \Gamma \vdash \lambda^{\uparrow} x.e : \sigma \xrightarrow{\uparrow}_{\pi} \tau}$$

$$\frac{\Phi | \Gamma \vdash e_1 : \sigma \xrightarrow{\uparrow}_{\pi} \tau \quad \Phi | \Gamma' \vdash e_2 : \sigma}{\Phi | \Gamma, \pi \Gamma' \vdash e_1(^{\uparrow} e_2) : \tau}$$

$$\frac{\Phi \vdash \sigma : * \quad \Phi \vdash \tau : * \quad \Phi \vdash \pi : \text{Multiplicity}}{\Phi \vdash \sigma \xrightarrow{\uparrow}_{\pi} \tau : *}$$

6.3 System-F

$$\begin{array}{rll} e ::= & & \\ & \Lambda \alpha \cdot e & \text{(Type Lambda)} \\ & e(\sigma) & \text{(Type Application)} \\ & \cdots & \\ \sigma, \tau, \pi, \kappa, \rho ::= & & \\ & \forall \alpha :^{c} \kappa . \sigma & \text{(Type Poly)} \\ & \cdots & \end{array}$$

$$\frac{\Phi, \alpha :^{c} \kappa \, | \, \Gamma \vdash e : \sigma}{\Phi | \Gamma \vdash \Lambda \alpha . e : \forall \alpha :^{c} \kappa . \sigma}$$

$$\frac{\Phi|\Gamma \vdash e : \forall \alpha :^c \kappa.\sigma \quad \Phi \vdash \tau : \kappa \quad \Phi \Vdash^c \tau}{\Phi|\Gamma \vdash e(\tau) : \sigma[\tau/\alpha]}$$

$$\frac{\Phi, \alpha :^\circ \kappa \vdash \sigma : * \quad \Phi \vdash \kappa : \square^\tau}{\Phi \vdash \forall \alpha :^c \kappa.\sigma : *}$$

7 Runtime

$\sigma, \tau, \pi, \kappa, \rho ::=$

$+^\rho_\pi$	(Pretype)
Representation	(Representation)
$\ldots$	

$$\frac{\Phi \vdash \rho :^\tau \text{Representation} \quad \Phi \vdash \pi : \text{Multiplicity}}{\Phi \vdash +^\rho_\pi : \square^{\text{Syntactic}}}$$

$$\frac{}{\Phi \vdash \text{Representation} : \square^{\text{Syntactic}}}$$

7.1 Regions

todo add proper patterns to rules
Regions use boolean unification where `pure` (`false`) means using no regions.

$e ::=$

$\text{letRGN}\,(\Lambda\alpha.e)$	(Bind Region Type Variable (Unused))
$\text{let}^\downarrow\, x = e; e'$	(Runtime Let)
$\text{case}\, e\, \text{of}\{x \to e'; x' \to' e''\}$	(Case)
$\ldots$	

$\sigma, \tau, \pi, \kappa ::=$

σ^π	(Region Effect)
IO	(IO Region)
Region	(Region)
$\ldots$	

$$\frac{\Phi, \alpha : \text{Region} \,|\, \Gamma \vdash e : \sigma^{\pi \vee (\alpha \wedge \rho)} \quad \alpha \notin \text{Free}(\sigma, \pi)}{\Phi | \Gamma \vdash \text{letRGN}\ (\Lambda \alpha . e) : \sigma^{\pi}}$$

$$\frac{\Phi | \Gamma \vdash e : \tau^{\pi} \quad \Phi \vdash \tau : +^{\rho}_{\kappa} \quad \Phi | \Gamma', x :^{\kappa} \tau^{\texttt{pure}} \vdash e' : \sigma^{\pi'} \quad \Phi \Vdash^{\bullet} \rho}{\Phi | \Gamma, \Gamma' \vdash \text{let}^{\downarrow}\, x = e; e' : \sigma^{\pi \vee \pi'}}$$

$$\frac{\Phi | \Gamma \vdash e : \tau^{\pi} \quad \Phi \vdash \tau : +^{\rho}_{\kappa} \quad \overline{\Phi | \Gamma', x :^{\kappa} \tau^{\texttt{pure}} \vdash e' : \sigma^{\pi}} \quad \Phi \Vdash^{\bullet} \rho}{\Phi | \Gamma, \overline{\Gamma'} \vdash \text{case}\, e\, \text{of} \{ \overline{x' \to e'} \} : \sigma^{\pi \vee \overline{\pi'}}}$$

$$\frac{\Phi \vdash \pi : \text{Region} \quad \Phi \vdash \sigma : +^{\rho}_{\tau}}{\Phi \vdash \sigma^{\pi} : *}$$

$$\frac{}{\Phi \vdash \text{IO} : \text{Region}}$$

$$\frac{}{\Phi \vdash \text{Region} : \Box^{\text{Propositional}}}$$

7.2 Boxed

$\sigma, \tau, \pi ::=$

$\text{unique}\, \sigma$	
$\sigma \mathbin{@} \pi$	
$-$	(Boxed)
Pointer	(Pointer Representation)
$\ldots$	

$$\frac{\Phi \vdash \sigma : -}{\Phi \vdash \text{unique}\, \sigma : +^{\text{Pointer}}_{1}}$$

$$\frac{\Phi \vdash \sigma : - \quad \pi : \text{Region}}{\Phi \vdash \sigma \mathbin{@} \pi : +^{\text{Pointer}}_{\omega}}$$

$$\frac{}{\Phi \vdash - : \square^{\text{Syntactic}}}$$

$$\frac{}{\Phi \vdash \text{Pointer} : \text{Representation}}$$

7.3 Pointers

$$\begin{array}{rll} e ::= & & \\ & * e & \text{(Read Pointer)} \\ & * e = e' & \text{(Write Pointer)} \\ & \&* & \text{(Array to Pointer)} \\ & \&e[e'] & \text{(Array Increment)} \\ & \cdots & \\ \sigma, \tau, \pi, \kappa, \rho ::= & & \\ & \sigma* & \text{(Pointer)} \\ & \sigma[] & \text{(Array Pointer)} \end{array}$$

$$\frac{\Phi|\Gamma \vdash e : (\sigma * \ @\pi')^{\pi} \quad \Phi \vdash \sigma : +^{\rho}_{\omega} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma \vdash *e : \sigma^{\pi \vee \pi'}}$$

$$\frac{\Phi|\Gamma \vdash e : (\sigma * \ @\pi')^{\pi} \quad \Phi|\Gamma \vdash e' : \sigma^{\pi''} \quad \Phi \vdash \sigma : +^{\rho}_{\omega} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma \vdash *e = e' : ()^{\pi \vee \pi' \vee \pi''}}$$

$$\frac{\Phi|\Gamma \vdash e : (\sigma[]@\pi')^{\pi}}{\Phi|\Gamma \vdash \& * e : (\sigma * @\pi')^{\pi}}$$

$$\frac{\Phi|\Gamma \vdash e : (\sigma[]@\pi')^{\pi} \quad \Phi|\Gamma' \vdash e' : (\text{unsigned integer(native)})^{\pi} \quad \Phi \vdash \sigma : +^{\rho}_{\tau} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma, \Gamma' \vdash \&e[e'] : (\sigma[]@\pi')^{\pi}}$$

$$\frac{\Phi \vdash \sigma : +^{\rho}_{\sigma}}{\Phi \vdash \sigma* : -}$$

$$\frac{\Phi \vdash \sigma : +^{\rho}_{\sigma}}{\Phi \vdash \sigma[] : -}$$

7.4 Functions

`function` and $\sigma \xrightarrow{\text{text}}_{\pi} \tau$ are internal.

$$
\begin{aligned}
e ::= & \\
& \text{extern}\,\text{sym} && \text{(Extern Function)} \\
& e^{\downarrow}(e') && \text{(Function Pointer Application)} \\
& \text{function}(x).e && \text{(Function Literal)} \\
& \ldots & & \\
\sigma, \tau, \pi, \kappa, \rho ::= & \\
& \tau \xrightarrow{\downarrow}_{\pi} \sigma && \text{(Function Pointer)} \\
& \tau \xrightarrow{\text{text}}_{\pi} \sigma && \text{(Function Literal Type)} \\
& \ldots &&
\end{aligned}
$$

$$\frac{\Phi \vdash \tau : +^{\rho}_{\tau'} \quad \Phi \Vdash^{\bullet} \rho \quad \Phi \vdash \sigma : +^{\rho'}_{\tau''} \quad \Phi \Vdash^{\bullet} \rho'}{\Phi|\Gamma \vdash \text{extern}\,\text{sym} : (\tau \xrightarrow{\downarrow}_{\pi} \sigma)^{\texttt{pure}}}$$

$$\frac{\Phi|\Gamma \vdash e : (\sigma \xrightarrow{\downarrow}_{\pi'} \tau)^{\pi} \quad \Phi|\Gamma' \vdash e' : \sigma^{\pi''} \quad \Phi \vdash \tau : +^{\rho}_{\tau'} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma, \Gamma' \vdash e^{\downarrow}(e') : \tau^{\pi \vee \pi' \vee \pi''}}$$

$$\frac{\Phi|\Gamma, x :^{1} \sigma^{\texttt{pure}} \vdash e : \tau^{\pi} \quad \Phi \vdash \sigma : +^{\rho}_{\tau'} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma \vdash \text{function}(x).e : \sigma \xrightarrow{\text{text}}_{\pi} \tau}$$

$$\frac{\Phi \vdash \sigma : +^{\rho}_{\kappa} \quad \Phi \vdash \tau : +^{\rho'}_{\kappa'} \quad \Phi \vdash \pi : \text{Region}}{\Phi \vdash \sigma \xrightarrow{\downarrow}_{\pi} \tau : +^{\text{Pointer}}_{\omega}}$$

$$\frac{\Phi \vdash \sigma : +^{\rho}_{\kappa} \quad \Phi \vdash \tau : +^{\rho'}_{\kappa'} \quad \Phi \vdash \pi : \text{Region}}{\Phi \vdash \sigma \xrightarrow{\text{text}}_{\pi} \tau : *}$$

7.5 Tuples

$$
\begin{aligned}
e ::= & \\
& (\overline{e},) && \text{(Tuple Introduction)}
\end{aligned}
$$

$$
\begin{array}{rll}
 & \mathrm{let}^{\downarrow}(\overline{x}) = e; e' & \text{(Tuple Elimination)} \\
 & \dots & \\
\sigma, \tau, \pi, \kappa, \rho ::= & & \\
 & (\overline{\sigma},) & \text{(Tuple)} \\
 & \mathrm{Struct}\{\overline{\rho}\} & \text{(Struct Representation)} \\
 & \dots &
\end{array}
$$

$$
\frac{\Phi | \overline{\Gamma \vdash e : \sigma^{\pi}}}{\Phi | \overline{\Gamma} \vdash (\overline{e},) : (\overline{\sigma},)^{\vee \pi}}
$$

$$
\frac{\Phi | \Gamma \vdash e : (\overline{\tau},)^{\pi} \quad \Phi | \Gamma, \overline{x :^{1} \tau^{\mathtt{pure}}} \vdash e : \sigma^{\pi'} \quad \overline{\Phi \vdash \tau : +^{\rho}_{\kappa} \quad \Phi \Vdash^{\bullet} \rho}}{\Phi | \Gamma, \Gamma' \vdash \mathrm{let}^{\downarrow}(\overline{x}) = e; e' : \sigma^{\pi \vee \pi'}}
$$

$$
\frac{\Phi \vdash \overline{\sigma : +^{\kappa}_{\pi}}}{\Phi \vdash (\overline{\sigma},) : +^{\mathrm{Struct}\{\overline{\kappa}\}}_{\bigwedge \pi}}
$$

$$
\frac{\Phi \vdash \overline{\rho :^{\tau} \text{ Representation}}}{\Phi \vdash \mathrm{Struct}\{\overline{\rho}\} :^{\bigwedge \tau} \text{ Representation}}
$$

7.6 Choices

$$
\begin{array}{rll}
\sigma, \tau, \pi, \kappa, \rho ::= & & \\
 & \mathrm{Union}\{\overline{\rho}\} & \text{(Union Representation)} \\
 & \dots &
\end{array}
$$

$$
\frac{\Phi \vdash \overline{\rho :^{\tau} \text{ Representation}}}{\Phi \vdash \mathrm{Union}\{\overline{\rho}\} :^{\bigwedge \tau} \text{ Representation}}
$$

7.7 Integer Arithmatic

$$
\begin{array}{rll}
e ::= & & \\
 & n & \text{(Numeric Literal)} \\
 & e + e' & \text{(Addition)}
\end{array}
$$

$$
\begin{array}{rl}
 & e - e' \qquad \text{(Subtraction)} \\
 & e * e' \qquad \text{(Multiplication)} \\
 & e / e' \qquad \text{(Division)} \\
 & e = e' \qquad \text{(Equality)} \\
 & e \neq e' \qquad \text{(Inequality)} \\
 & e < e' \qquad \text{(Less Then)} \\
 & e \leqslant e' \qquad \text{(Less Then Equal)} \\
 & e > e' \qquad \text{(Greater Then)} \\
 & e \geqslant e' \qquad \text{(Greater Then Equal)} \\
 & \ldots \\
\sigma, \tau, \pi ::= & \\
 & \rho\,\mathrm{integer}(\rho) \qquad \text{(Number)} \\
 & \ldots \\
\sigma, \tau, \pi, \kappa, \rho ::= & \\
 & \mathrm{Word}(\rho) \qquad \text{(Word Representation)} \\
 & 8 \qquad \text{(Byte Size)} \\
 & 16 \qquad \text{(Short Size)} \\
 & 32 \qquad \text{(Int Size)} \\
 & 64 \qquad \text{(Long Size)} \\
 & \mathrm{native} \qquad \text{(Native Size)} \\
 & \mathrm{signed} \qquad \text{(Signed)} \\
 & \mathrm{unsigned} \qquad \text{(Unsigned)} \\
 & \mathrm{Size} \qquad \text{(Size Sort)} \\
 & \mathrm{Signedness} \qquad \text{(Signedness Sort)} \\
 & \ldots
\end{array}
$$

$$
\frac{\Phi \Vdash^{\bullet} \rho'}{\Phi|\Gamma \vdash n : (\rho\,\mathrm{integer}(\rho'))^{\mathtt{pure}}}
$$

$$
\frac{\Phi|\Gamma \vdash e : (\rho\,\mathrm{integer}(\rho'))^{\pi} \quad \Phi|\Gamma, \Gamma' \vdash e' : (\rho\,\mathrm{integer}(\rho'))^{\pi'} \quad \Phi \Vdash^{\bullet} \rho \quad \Phi \Vdash^{\bullet} \rho'}{\Phi|\Gamma, \Gamma' \vdash e + e' : (\rho\mathrm{integer}(\rho'))^{\pi \vee \pi'}}
$$

$$
\ldots
$$

$$
\frac{\Phi|\Gamma \vdash e : (\rho\,\mathrm{integer}(\rho'))^{\pi} \quad \Phi|\Gamma, \Gamma' \vdash e' : (\rho\,\mathrm{integer}(\rho'))^{\pi'} \quad \Phi \Vdash^{\bullet} \rho \quad \Phi \Vdash^{\bullet} \rho'}{\Phi|\Gamma, \Gamma' \vdash e < e' : \mathrm{Boolean}^{\pi \vee \pi'}}
$$

...

$$\frac{\Phi \vdash \rho :^{\tau} \text{Signedness} \quad \Phi \vdash \rho' :^{\tau'} \text{Size}}{\Phi \vdash \rho\, \text{integer}(\rho') : +_{\omega}^{\text{Word}(\rho')}}$$

$$\frac{\Phi \vdash \rho :^{\tau} \text{Size}}{\Phi \vdash \text{Word}(\rho) :^{\tau} \text{Representation}}$$

$$\frac{}{\Phi \vdash 8 : \text{Size}}$$

$$\frac{}{\Phi \vdash 16 : \text{Size}}$$

$$\frac{}{\Phi \vdash 32 : \text{Size}}$$

$$\frac{}{\Phi \vdash 64 : \text{Size}}$$

$$\frac{}{\Phi \vdash \text{native} : \text{Size}}$$

$$\frac{}{\Phi \vdash \text{signed} : \text{Signedness}}$$

$$\frac{}{\Phi \vdash \text{unsigned} : \text{Signedness}}$$

$$\frac{}{\Phi \vdash \text{Size} : \square^{\text{Syntactic}}}$$

$$\frac{}{\Phi \vdash \text{Signedness} : \square^{\text{Syntactic}}}$$

7.8 Boolean Logic

Note this has nothing to do with boolean unification.

$$e ::=$$
$$\text{true}$$
$$\text{false}$$

$$\begin{array}{rl} & \mathrm{if}(e)\{e'\}\mathrm{else}\{e''\} \\ \sigma, \tau, \pi, \kappa, \rho ::= & \\ & \mathrm{Boolean} \end{array}$$

$$\frac{}{\Phi|\Gamma \vdash \mathrm{true} : \mathrm{Boolean}^{\mathtt{pure}}}$$

$$\frac{}{\Phi|\Gamma \vdash \mathrm{false} : \mathrm{Boolean}^{\mathtt{pure}}}$$

$$\frac{\Phi|\Gamma \vdash e : \mathrm{Boolean}^{\pi} \quad \Phi|\Gamma' \vdash e' : \sigma^{\pi'} \quad \Phi|\Gamma' \vdash e'' : \sigma^{\pi''}}{\Phi|\Gamma, \Gamma' \vdash \mathrm{if}(e)\{e'\}\mathrm{else}\{e''\} : \sigma^{\pi \vee \pi' \vee \pi''}}$$

$$\frac{}{\Phi \vdash \mathrm{Boolean} : +_{\omega}^{\mathrm{Word}(8)}}$$

7.9 Loops

$$\begin{array}{rll} & e ::= & \\ & \quad \mathrm{continue}\, e & (\mathrm{continue}) \\ & \quad \mathrm{break}\, e & (\mathrm{break}) \\ & \quad \mathrm{loop}(\mathrm{let}\, x = e)\{e'\} & (\mathrm{loop}) \\ \sigma, \tau, \pi, \kappa, \rho ::= & & \\ & \quad \mathrm{Step}\, \sigma\, \tau & (\text{Loop Instruction}) \end{array}$$

$$\frac{\Phi|\Gamma \vdash e : \sigma^{\pi}}{\Phi|\Gamma \vdash \mathrm{continue}\, e : (\mathrm{Step}\, \tau\, \sigma)^{\pi}}$$

$$\frac{\Phi|\Gamma \vdash e : \tau^{\pi} \quad \Phi \vdash \sigma : +_{\kappa}^{\rho} \quad \Phi \Vdash^{\bullet} \rho}{\Phi|\Gamma \vdash \mathrm{break}\, e : (\mathrm{Step}\, \tau\, \sigma)^{\pi}}$$

$$\frac{\Phi|\Gamma \vdash e : \sigma^{\pi} \quad \Phi|\Gamma', x :^{1} \sigma^{\mathtt{pure}} \vdash e' : (\mathrm{Step}\, \tau\, \sigma)^{\pi'}}{\Phi|\Gamma, \omega\Gamma' \vdash \mathrm{loop}(\mathrm{let}\, x = e)\{e'\} : \tau^{\pi \vee \pi'}}$$

$$\frac{\Phi \vdash \sigma : +_{\pi}^{\rho} \quad \Phi \vdash \tau : +_{\pi'}^{\rho}}{\Phi \vdash \mathrm{Step}\, \sigma\, \tau : +_{1}^{\mathrm{Struct}(\mathrm{Word}(8), \mathrm{Union}(\rho, \rho'))}}$$

8 Erasure Entailment

$$\frac{}{\Phi \Vdash^{\circ} \sigma}$$

$$\frac{(x :^{\bullet} \kappa) \in \Phi}{\Phi \Vdash^{\bullet} x}$$

$$\frac{}{\Phi \Vdash^{\bullet} \text{Pointer}}$$

$$\frac{\overline{\Phi \Vdash^{\bullet} \sigma}}{\Phi \Vdash^{\bullet} \text{Struct}\{\overline{\sigma}\}}$$

$$\frac{\overline{\Phi \Vdash^{\bullet} \sigma}}{\Phi \Vdash^{\bullet} \text{Union}\{\overline{\sigma}\}}$$

$$\frac{\Phi \Vdash^{\bullet} \sigma}{\Phi \Vdash^{\bullet} \text{Word}(\sigma)}$$

$$\frac{}{\Phi \Vdash^{\bullet} 8}$$

$$\frac{}{\Phi \Vdash^{\bullet} 16}$$

$$\frac{}{\Phi \Vdash^{\bullet} 32}$$

$$\frac{}{\Phi \Vdash^{\bullet} 64}$$

$$\frac{}{\Phi \Vdash^{\bullet} \text{native}}$$

$$\frac{}{\Phi \Vdash^{\bullet} \text{unsigned}}$$

$$\frac{}{\Phi \Vdash^{\bullet} \text{signed}}$$