

References: Types

$T ::=$	types:
$T \rightarrow T$	type of functions
Unit	unit type
$\text{Ref } T$	type of reference cells

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References: Terms

Syntactic forms

$t ::=$	terms:
x	variables
$\lambda x: T. t$	abstraction
$t t$	application
unit	constant unit
$\text{ref } t$	reference creation
$!t$	dereference
$t := t$	assignment
l	store location

Store locations l can only appear in *internal* terms.

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References: Values

Syntactic forms

$v ::=$	values:
$\lambda x: T. t$	abstraction value
unit	constant unit
l	store location

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References: Contexts, Stores and Store Typings

$\Gamma ::=$	contexts:
\emptyset	empty context
$\Gamma, x: T$	term variable binding

$\mu ::=$	stores:
\emptyset	empty store
$\mu, l \mapsto v$	location binding

$\Sigma ::=$	store typings:
\emptyset	empty store typing
$\Sigma, l: T$	location typing

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References: Evaluation

Evaluation: $t \mid \mu \rightarrow t' \mid \mu'$

$$\frac{t_1 \mid \mu \rightarrow t'_1 \mid \mu'}{t_1 t_2 \mid \mu \rightarrow t'_1 t_2 \mid \mu'} \quad (\text{E-App1})$$

$$\frac{t_2 \mid \mu \rightarrow t'_2 \mid \mu'}{v_1 t_2 \mid \mu \rightarrow v_1 t'_2 \mid \mu'} \quad (\text{E-App2})$$

$$(\lambda x: T_{11}. t_{12})v_2 \mid \mu \rightarrow [x \mapsto v_2]t_{12} \mid \mu \quad (\text{E-AppAbs})$$

$$\frac{l \notin \text{dom}(\mu)}{\text{ref } v_1 \mid \mu \rightarrow l \mid (\mu, l \mapsto v_1)} \quad (\text{E-RefV})$$

$$\frac{t_1 \mid \mu \rightarrow t'_1 \mid \mu'}{\text{ref } t_1 \mid \mu \rightarrow \text{ref } t'_1 \mid \mu'} \quad (\text{E-Ref})$$

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References: Evaluation (Cont.)

Evaluation: $t \mid \mu \rightarrow t' \mid \mu'$

$$\frac{\mu(l) = v}{!l \mid \mu \rightarrow v \mid \mu} \quad (\text{E-DerefLoc})$$

$$\frac{t_1 \mid \mu \rightarrow t'_1 \mid \mu'}{!t_1 \mid \mu \rightarrow !t'_1 \mid \mu'} \quad (\text{E-Deref})$$

$$l := v_2 \mid \mu \rightarrow \text{unit} \mid [l \mapsto v_2]\mu \quad (\text{E-Assign})$$

$$\frac{t_1 \mid \mu \rightarrow t'_1 \mid \mu'}{t_1 := t_2 \mid \mu \rightarrow t'_1 := t_2 \mid \mu'} \quad (\text{E-Assign1})$$

$$\frac{t_2 \mid \mu \rightarrow t'_2 \mid \mu'}{v_1 := t_2 \mid \mu \rightarrow v_1 := t'_2 \mid \mu'} \quad (\text{E-Assign2})$$

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References: Typing

$\Gamma \mid \Sigma \vdash t : T$

$$\frac{x : T \in \Gamma}{\Gamma \mid \Sigma \vdash x : T} \quad (\text{T-Var})$$

$$\frac{\Gamma, x : T_1 \mid \Sigma \vdash t_2 : T_2}{\Gamma \mid \Sigma \vdash \lambda x : T_1. t_2 : T_1 \rightarrow T_2} \quad (\text{T-Abs})$$

$$\frac{\Gamma \mid \Sigma \vdash t_1 : T_{11} \rightarrow T_{12} \quad \Gamma \mid \Sigma \vdash t_2 : T_{11}}{\Gamma \mid \Sigma \vdash t_1 t_2 : T_{12}} \quad (\text{T-App})$$

$$\Gamma \mid \Sigma \vdash \text{unit} : \text{Unit} \quad (\text{T-Unit})$$

$\Sigma = \emptyset$ when typing external language.

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References: Typing (Cont.)

$\Gamma \mid \Sigma \vdash t : T$

$$\frac{\Sigma(l) = T_1}{\Gamma \mid \Sigma \vdash l : \text{Ref } T_1} \quad (\text{T-Loc})$$

$$\frac{\Gamma \mid \Sigma \vdash t_1 : T_1}{\Gamma \mid \Sigma \vdash \text{ref } t_1 : \text{Ref } T_1} \quad (\text{T-Ref})$$

$$\frac{\Gamma \mid \Sigma \vdash t_1 : \text{Ref } T_{11}}{\Gamma \mid \Sigma \vdash !t_1 : T_{11}} \quad (\text{T-Deref})$$

$$\frac{\Gamma \mid \Sigma \vdash t_1 : \text{Ref } T_{11} \quad \Gamma \mid \Sigma \vdash t_2 : T_{11}}{\Gamma \mid \Sigma \vdash t_1 := t_2 : \text{Unit}} \quad (\text{T-Assign})$$

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