The Cedilleum Language Specification

Syntax, Typing, Reduction, and Elaboration

Christopher Jenkins

June 15, 2018

1 Syntax

id			identifiers for definitions
u			term variables
X			type variables
k			kind variables
x	$::=$	$id \mid u \mid X \mid k$	any variable

Figure 1: Identifiers

$$
\begin{array}{rcl}
uterms & ::= & u \\
 & & \lambda\, u.\, uterm \\
 & & uterm\ uterm
\end{array}
$$

Figure 2: Untyped terms

mod	::=	**module** id **.** $imprt^*$ cmd^*	module declarations
$imprt$	::=	**import** id **.**	module imports
cmd	::=	$defTermOrType$	definitions
		$defDataType$	
		$defKind$	
$defTermOrType$	::=	id $checkType^?$ $=$ $term$ **.**	term definition
		$id \triangleleft kind = type$ **.**	type definition
$defDataType$	::=	**data** id $param^*$ **:** $kind$ $=$ $constr^*$ **.**	datatype definitions
$defKind$	::=	$k = kind$	
$checkType$	::=	**:** $type$	annotation for term definition
$param$	::=	$(x$ **:** $typeOrKind)$	
$typeOrKind$	::=	$type$	
		$kind$	
$constr$	::=	$\mid$ id **:** $type$	

Figure 3: Modules and definitions

$kind$	::=	$\star$	
		$\Pi\ x$ **:** $typeOrKind$ **.** $kind$	explicit product
		$typeOrKind \to kind$	kind arrow
		$k\ term$	
		$k \cdot type$	
$type$	::=	X	
		$\Pi\ x$ **:** $type$ **.** $type$	explicit product
		$\forall\ x$ **:** $typeOrKind$ **.** $type$	implicit product
		$\lambda\ x$ **:** $typeOrKind$ **.** $type$	type-level function
		$type \to type$	normal arrow type
		$type \Rightarrow type$	arrow with erased domain
		$type \cdot type$	
		$type\ term$	
		$\{\ uterm\ \simeq\ uterm\}$	untyped equality

Figure 4: Kinds and types

$term$	::=	x	
		$\lambda\ x\ class^?\ \mathbf{.}\ term$	normal abstraction
		$\Lambda\ x\ class^?\ \mathbf{.}\ term$	erased abstraction
		$[\ defTermOrType\ ]\ \mathbf{-}\ term$	let
		$term\ arg^*$	applications
		$\beta\ \mathbf{\{}term\mathbf{\}}$	reflexivity of equality
		$\varsigma\ term$	symmetry of equality
		$\rho\ term\ \mathbf{-}\ term$	equality elimination by rewriting
		$\delta\ \mathbf{-}\ term$	ex falso quodlibet
		$\phi\ term\ \mathbf{-}\ term\ \mathbf{\{}term\mathbf{\}}$	type cast
		$\chi\ type^?\ \mathbf{-}\ term$	check a term against a type
		$\mu\ term\ motive^?\ \mathbf{\{}\ case^*\ \mathbf{\}}$	pattern match and fixpoint
arg	::=	$term$	normal application
		$\mathbf{-}\ term$	application to erased term
		$\cdot\ term$	application to type
$class$	::=	$\mathbf{:}\ typeOrKind$	
$motive$	::=	$\mathbf{@}\ type$	motive for induction
$case$	::=	$\mid\ id\ arg^*\ \mathbf{.}\ term$	

Figure 5: Annotated Terms