

$tvar, x$	term variable		
$Tvar, X$	type variable		
$type, T, U$	$::=$		type
	<b>Top</b>		top
	$X$		variable
	$T \rightarrow U$		function
	$\forall X <: U. T$	bind $X$ in $T$	forall
	$(T)$	S	
	$[X \mapsto U] T$	M	
$term, t$	$::=$		term
	$x$		variable
	$\lambda x : T. t$	bind $x$ in $t$	abstraction
	$t_1 t_2$		application
	$\lambda X <: T. t$	bind $X$ in $t$	type abstraction
	$t[T]$		type application
	$(t)$	S	
	$\{t_1/x\} t_2$	M	
	$[X \mapsto T] t$	M	
$value, v$	$::=$		value
	$\lambda x : T. t$	bind $x$ in $t$	abstraction
	$\lambda X <: T. t$	bind $X$ in $t$	type abstraction
$bind$	$::=$		environnement bindings
	$: T$		
	$<: T$		
$env, E$	$::=$		type environment
	<b>empty</b>		
	$env, x \text{ bind}$		
	$env, X \text{ bind}$		
$formula$	$::=$		
	<i>judgement</i>		
	$X <: T \text{ in } env$		
	$x : T \text{ in } env$		
	<b>ok</b> $env$		
	$x \# E$		
	$X \# E$		
$terminals$	$::=$		
	$\lambda$		
	$\rightarrow$		
	$\vdash$		
	$\longrightarrow$		
	$\forall$		
	$<:$		
	$\mapsto$		

		$\wedge$	
		$\vee$	
		$=$	
<i>wft</i>	::=	$E \vdash T$	$T$ is well formed in environment $E$
<i>okt</i>	::=	$\vdash E$	$E$ is well formed
<i>subtyping</i>	::=	$E \vdash U <: T$	$U$ is a subtype of $T$
<i>typing</i>	::=	$E \vdash t : T$	
<i>red</i>	::=	$t_1 \longrightarrow t_2$	$t_1$ reduces to $t_2$
<i>judgement</i>	::=	<i>wft</i>	
		<i>okt</i>	
		<i>subtyping</i>	
		<i>typing</i>	
		<i>red</i>	
<i>user_syntax</i>	::=	<i>tvar</i>	
		<i>Tvar</i>	
		<i>type</i>	
		<i>term</i>	
		<i>value</i>	
		<i>bind</i>	
		<i>env</i>	
		<i>formula</i>	
		<i>terminals</i>	

$\boxed{E \vdash T}$   $T$  is well formed in environment  $E$

$\overline{E \vdash \mathbf{Top}}$	WFT_TOP
$\frac{X <: U \text{ in } E}{E \vdash X}$	WFT_VAR
$\frac{E \vdash T_1 \quad E \vdash T_2}{E \vdash T_1 \rightarrow T_2}$	WFT_ARROW
$\frac{E \vdash T_1 \quad E, X <: T_1 \vdash T_2}{E \vdash \forall X <: T_1. T_2}$	WFT_ALL

$\boxed{\vdash E}$   $E$  is well formed

$$\begin{array}{c}
\overline{\vdash \mathbf{empty}} \quad \text{OKT\_EMPTY} \\
\vdash E \\
X \# E \\
E \vdash T \\
\hline
\vdash E, X <: T \quad \text{OKT\_SUB} \\
\vdash E \\
x \# E \\
E \vdash T \\
\hline
\vdash E, x : T \quad \text{OKT\_TYP}
\end{array}$$

$\boxed{E \vdash U <: T}$   $U$  is a subtype of  $T$

$$\begin{array}{c}
\vdash E \\
E \vdash T \\
\hline
E \vdash T <: \mathbf{Top} \quad \text{SUB\_TOP} \\
\vdash E \\
E \vdash X \\
\hline
E \vdash X <: X \quad \text{SUB\_REFL\_TVAR} \\
X <: U \mathbf{in} E \\
E \vdash U <: T \\
\hline
E \vdash X <: T \quad \text{SUB\_TRANS\_TVAR} \\
E \vdash T_1 <: U_1 \\
E \vdash U_2 <: T_2 \\
\hline
E \vdash U_1 \rightarrow U_2 <: T_1 \rightarrow T_2 \quad \text{SUB\_ARROW} \\
E \vdash T_1 <: U_1 \\
E, X <: T_1 \vdash U_2 <: T_2 \\
\hline
E \vdash \forall X <: U_1. U_2 <: \forall X <: T_1. T_2 \quad \text{SUB\_ALL}
\end{array}$$

$\boxed{E \vdash t : T}$

$$\begin{array}{c}
\vdash E \\
x : T \mathbf{in} E \\
\hline
E \vdash x : T \quad \text{TYPING\_VAR} \\
E, x : U \vdash t : T \\
\hline
E \vdash \lambda x : U. t : U \rightarrow T \quad \text{TYPING\_ABS} \\
E \vdash t_1 : U \rightarrow T \\
E \vdash t_2 : U \\
\hline
E \vdash t_1 t_2 : T \quad \text{TYPING\_APP} \\
E, X <: U \vdash t : T \\
\hline
E \vdash \lambda X <: U. t : \forall X <: U. T \quad \text{TYPING\_TABS} \\
E \vdash t : \forall X <: T_1. T_2 \\
E \vdash T <: T_1 \\
\hline
E \vdash t[T] : [X \mapsto T] T_2 \quad \text{TYPING\_TAPP} \\
E \vdash t : U \\
E \vdash U <: T \\
\hline
E \vdash t : T \quad \text{TYPING\_SUB}
\end{array}$$

$t_1 \longrightarrow t_2$   $t_1$  reduces to  $t_2$

$$\frac{t_1 \longrightarrow t'_1}{t_1 t_2 \longrightarrow t'_1 t_2} \text{ APP-1}$$

$$\frac{t_2 \longrightarrow t'_2}{v_1 t_2 \longrightarrow v_1 t'_2} \text{ APP-2}$$

$$\frac{t_1 \longrightarrow t'_1}{t_1 [T] \longrightarrow t'_1 [T]} \text{ TAPP}$$

$$\frac{}{(\lambda x : T. t_1) v_2 \longrightarrow \{v_2 / x\} t_1} \text{ ABS}$$

$$\frac{}{(\lambda X <: T_1. t_1) [T_2] \longrightarrow [X \mapsto T_2] t_1} \text{ TABS}$$

Definition rules: 23 good 0 bad

Definition rule clauses: 57 good 0 bad