x term variable
α type variable
T type constructor

t	::=		term
	$\vert$	x	variable
	$\vert$	$\lambda(x : \tau) \Rightarrow t$	abstraction
	$\vert$	$\lambda\{\alpha : \kappa\} \Rightarrow t$	type abstraction
	$\vert$	$t_1\ t_2$	application
	$\vert$	$t\ [\tau]$	type application
	$\vert$	$t : \tau$	type annotation
v	::=		value
	$\vert$	$\lambda(x : \tau) \Rightarrow t$	abstraction
κ	::=		kind
	$\vert$	$*$	star
	$\vert$	$\kappa_1 \rightarrow \kappa_2$	kind arrow
τ	::=		type
	$\vert$	α	type variable
	$\vert$	T	type constructor
	$\vert$	$\tau_1 \rightarrow \tau_2$	$\equiv (\rightarrow)\ \tau_1\ \tau_2$
	$\vert$	$\lambda(\alpha : \kappa), \tau$	operator abstraction
	$\vert$	$\forall\,(\alpha : \kappa), \tau$	universal quantification
	$\vert$	$\tau_1\, \tau_2$	operator application
Γ	::=		typing environment
	$\vert$	$\emptyset$	empty
	$\vert$	$\Gamma, x : \tau$	variable
	$\vert$	$\Gamma, T : \kappa$	type constructor
	$\vert$	$\Gamma, \alpha : \kappa$	type variable

Initial environment: $\Gamma = \emptyset,\ (\rightarrow) : * \rightarrow * \rightarrow *$

$\boxed{[\alpha \mapsto \tau_1]\ \tau_2 \rhd \tau_3}$ Type substitution

$$\frac{}{[\alpha \mapsto \tau]\ \alpha \rhd \tau}\ \textsc{SubstT\_Var1}$$

$$\frac{\alpha_1 \neq \alpha_2}{[\alpha_1 \mapsto \tau]\ \alpha_2 \rhd \alpha_2}\ \textsc{SubstT\_Var2}$$

$$\frac{}{[\alpha \mapsto \tau]\ T \rhd T}\ \textsc{SubstT\_Type}$$

$$\frac{[\alpha_1 \mapsto \tau_1]\ \tau_2 \rhd \tau_2'}{[\alpha_1 \mapsto \tau_1]\ (\lambda(\alpha_2 : \kappa), \tau_2) \rhd (\lambda(\alpha_2 : \kappa), \tau_2')}\ \textsc{SubstT\_Abs}$$

$$\frac{[\alpha_1 \mapsto \tau_1]\ \tau_2 \rhd \tau_2'}{[\alpha_1 \mapsto \tau_1]\ (\forall\,(\alpha_2 : \kappa), \tau_2) \rhd (\forall\,(\alpha_2 : \kappa), \tau_2')}\ \textsc{SubstT\_Forall}$$

$$\frac{[\alpha \mapsto \tau_1]\ \tau_2 \rhd \tau_2' \qquad [\alpha \mapsto \tau_1]\ \tau_3 \rhd \tau_3'}{[\alpha \mapsto \tau_1]\ \tau_2\,\tau_3 \rhd \tau_2'\,\tau_3'} \quad \textsc{SubstT\_App}$$

$\boxed{\Gamma \vdash t : \tau}$ Typing rules

$$\frac{x : \tau \ \in \ \Gamma}{\Gamma \vdash x : \tau} \quad \textsc{T\_Var}$$

$$\frac{\Gamma, x : \tau_1 \vdash t : \tau_2 \qquad \Gamma \vdash \tau_1 : *}{\Gamma \vdash (\lambda(x : \tau_1) \Rightarrow t) : \tau_1 \to \tau_2} \quad \textsc{T\_Abs}$$

$$\frac{\Gamma, \alpha : \kappa \vdash t : \tau \qquad \alpha \notin \Gamma}{\Gamma \vdash (\lambda\{\alpha : \kappa\} \Rightarrow t) : \forall\,(\alpha : \kappa), \tau} \quad \textsc{T\_TyAbs}$$

$$\frac{\Gamma \vdash t_1 : \tau_2 \to \tau_1 \qquad \tau_2 \equiv \tau_2' \qquad \Gamma \vdash t_2 : \tau_2'}{\Gamma \vdash t_1\ t_2 : \tau_1} \quad \textsc{T\_App}$$

$$\frac{\Gamma \vdash t : \forall\,(\alpha : \kappa), \tau_2 \qquad \Gamma \vdash \tau_1 : \kappa \qquad [\alpha \mapsto \tau_1]\ \tau_2 \rhd \tau_2'}{\Gamma \vdash t\ [\tau_1] : \tau_2'} \quad \textsc{T\_TyApp}$$

$$\frac{\Gamma \vdash t : \tau_2 \qquad \tau_1 \equiv \tau_2}{\Gamma \vdash (t : \tau_1) : \tau_1} \quad \textsc{T\_Annot}$$

$\boxed{\Gamma \vdash \tau : \kappa}$ Kinding rules

$$\frac{\alpha : \kappa \ \in \ \Gamma}{\Gamma \vdash \alpha : \kappa} \quad \textsc{K\_Var}$$

$$\frac{T : \kappa \ \in \ \Gamma}{\Gamma \vdash T : \kappa} \quad \textsc{K\_TypeConstr}$$

$$\frac{\Gamma, \alpha : \kappa_1 \vdash \tau : \kappa_2}{\Gamma \vdash (\lambda(\alpha : \kappa_1), \tau) : \kappa_1 \to \kappa_2} \quad \textsc{K\_Abs}$$

$$\frac{\Gamma \vdash \tau_1 : \kappa_2 \to \kappa_1 \qquad \Gamma \vdash \tau_2 : \kappa_2}{\Gamma \vdash \tau_1\,\tau_2 : \kappa_1} \quad \textsc{K\_App}$$

$$\frac{\Gamma, \alpha : \kappa \vdash \tau : *}{\Gamma \vdash (\forall\,(\alpha : \kappa), \tau) : *} \quad \textsc{K\_Forall}$$

$\boxed{\tau_1 \equiv \tau_2}$ Type equivalence

$$\frac{}{\tau \equiv \tau} \quad \textsc{EQ\_Refl}$$

$$\frac{\tau_2 \equiv \tau_1}{\tau_1 \equiv \tau_2} \quad \textsc{EQ\_Sym}$$

$$\frac{\tau_1 \equiv \tau_2 \qquad \tau_2 \equiv \tau_3}{\tau_1 \equiv \tau_3} \quad \textsc{EQ\_Trans}$$

$$\frac{}{\alpha \equiv \alpha} \quad \text{EQ\_VAR}$$

$$\frac{}{T \equiv T} \quad \text{EQ\_TYPECONSTR}$$

$$\frac{\tau_1 \equiv \tau_2}{\forall\,(\alpha : \kappa), \tau_1 \equiv \forall\,(\alpha : \kappa), \tau_2} \quad \text{EQ\_FORALL}$$

$$\frac{\tau_1 \equiv \tau_2}{\lambda(\alpha : \kappa), \tau_1 \equiv \lambda(\alpha : \kappa), \tau_2} \quad \text{EQ\_ABS}$$

$$\frac{\begin{array}{c}\tau_1 \equiv \tau_1' \\ \tau_2 \equiv \tau_2'\end{array}}{\tau_1\,\tau_2 \equiv \tau_1'\,\tau_2'} \quad \text{EQ\_APP}$$

$$\frac{[\alpha \mapsto \tau_2]\ \tau_1 \rhd \tau_1'}{(\lambda(\alpha : \kappa), \tau_1)\,\tau_2 \equiv \tau_1'} \quad \text{EQ\_APPABS}$$

$\boxed{[x \mapsto v]\ t_1 \rhd t_2}$ substitution

$$\frac{}{[x \mapsto v]\ x \rhd v} \quad \text{SUBST\_VAR1}$$

$$\frac{x_1 \neq x_2}{[x_1 \mapsto v]\ x_2 \rhd x_2} \quad \text{SUBST\_VAR2}$$

$$\frac{}{[x \mapsto v]\ (\lambda(x : \tau) \Rightarrow t) \rhd (\lambda(x : \tau) \Rightarrow t)} \quad \text{SUBST\_ABS1}$$

$$\frac{[x_1 \mapsto v]\ t_1 \rhd t_2}{[x_1 \mapsto v]\ (\lambda(x_2 : \tau) \Rightarrow t_1) \rhd (\lambda(x_2 : \tau) \Rightarrow t_2)} \quad \text{SUBST\_ABS2}$$

$$\frac{[x \mapsto v]\ t_1 \rhd t_2}{[x \mapsto v]\ (\lambda\{\alpha : \kappa\} \Rightarrow t_1) \rhd (\lambda\{\alpha : \kappa\} \Rightarrow t_2)} \quad \text{SUBST\_TABS}$$

$$\frac{\begin{array}{c}[x \mapsto v]\ t_1 \rhd t_1' \\ [x \mapsto v]\ t_2 \rhd t_2'\end{array}}{[x \mapsto v]\ t_1\,t_2 \rhd t_1'\,t_2'} \quad \text{SUBST\_APP}$$

$$\frac{[x \mapsto v]\ t_1 \rhd t_2}{[x \mapsto v]\ (t_1\ [\tau]) \rhd (t_2\ [\tau])} \quad \text{SUBST\_TAPP}$$

$$\frac{[x \mapsto v]\ t_1 \rhd t_2}{[x \mapsto v]\ (t_1 : \tau) \rhd (t_2 : \tau)} \quad \text{SUBST\_ANNOT}$$

$\boxed{t_1 \longrightarrow t_2}$ Operational semantics

$$\frac{t_2 \longrightarrow t_2'}{t_1\,t_2 \longrightarrow t_1\,t_2'} \quad \text{E\_APP1}$$

$$\frac{t_1 \longrightarrow t_1'}{t_1\,v \longrightarrow t_1'\,v} \quad \text{E\_APP2}$$

$$\frac{\begin{array}{c}[x \mapsto v]\ t \rhd t' \\ t' \longrightarrow t''\end{array}}{(\lambda(x : \tau) \Rightarrow t)\,v \longrightarrow t''} \quad \text{E\_APPABS}$$

$$\frac{t \longrightarrow t'}{(\lambda\{\alpha : \kappa\} \Rightarrow t) \longrightarrow t'} \quad \text{E\_TABS}$$

$$\frac{t \longrightarrow t'}{t\ [\tau] \longrightarrow t'} \quad \text{E\_TApp}$$

$$\frac{t \longrightarrow t'}{t : \tau \longrightarrow t'} \quad \text{E\_Annot}$$

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Definition rules:         40 good    0 bad
Definition rule clauses: 86 good    0 bad
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