Long-distance interaction between caller and callee

Stephan Boyer and Esther Wang

$t ::=$		term
	v	value
	x	variable
	$t\ t$	application
	provide S as ε in t	provide
$v ::=$		value
	c	constant
	$\lambda x : \tau\ .\ t$	abstraction
$S ::=$		effect handler
	$\varnothing_S$	empty handler
	$S, s = t$	handler extension
$\Delta ::=$		effect context
	$\varnothing_\Delta$	empty effect context
	$\Delta, \varepsilon = \Gamma$	effect context extension
$\tau ::=$		type
	κ	type of constants
	$\sigma \to \sigma$	arrow type
$\sigma ::=$		type with effects
	$E\ !\ \tau$	effect annotation
$E ::=$		effect set
	$\varnothing_\varepsilon$	empty effect
	E, ε	effect extension
$\Gamma ::=$		context
	$\varnothing_\Gamma$	empty context
	$\Gamma, x : \tau$	variable binding

Figure 1: Syntax

$$\boxed{\Gamma \vdash t : \sigma}$$

$$\frac{}{\Gamma \vdash c : \varnothing_\varepsilon \mathbin{!} \kappa}\ (\text{T-Constant})$$

$$\frac{x : \sigma \in \Gamma}{\Gamma \vdash x : \sigma}\ (\text{T-Variable})$$

$$\frac{\Gamma, x : \tau \vdash t : \sigma}{\Gamma \vdash \lambda x : \tau\ .\ t : \tau \to \sigma}\ (\text{T-Abstraction})$$

$$\frac{\Gamma \vdash t_1 : E_1 \mathbin{!} \tau_1 \qquad \Gamma \vdash t_2 : E_2 \mathbin{!} (\tau_1 \to E_3 \mathbin{!} \tau_2)}{\Gamma \vdash t_2\ t_1 : E_1, E_2, E_3 \mathbin{!} \tau_2}\ (\text{T-Application})$$

$$\frac{\Gamma \vdash t : E \mathbin{!} \tau}{\Gamma \vdash t : E, \varepsilon \mathbin{!} \tau}\ (\text{T-Weaken})$$

$$\frac{\begin{array}{c} S = (\varnothing_S, s_1 = t_1, \ldots, s_n = t_n) \\ \Gamma \vdash t_i : E_i \mathbin{!} \tau_i \\ \sigma_i = E_i, \varepsilon \mathbin{!} \tau_i \\ \varepsilon = \varnothing_\Gamma, s_1 : \sigma_1, \ldots, s_n : \sigma_n \in \Delta \\ \Gamma, s_1 : \sigma_1, \ldots, s_n : \sigma_n \vdash t : E \mathbin{!} \tau \end{array}}{\Gamma \vdash \text{provide } S \text{ as } \varepsilon \text{ in } t : E - \varepsilon \mathbin{!} \tau}\ (\text{T-Provide})$$

Figure 2: Typing rules