

A Language for Staging

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1 Language Def

1.1 Grammar

$$\begin{aligned} \langle stage \rangle &= 1 \mid 2 \\ \langle expr \rangle &= f \langle expr \rangle \\ &\mid ()_{\langle stage \rangle} \\ &\mid (\langle expr \rangle, \langle expr \rangle) \\ &\mid \pi_1 \langle expr \rangle \\ &\mid \pi_2 \langle expr \rangle \\ &\mid \text{let } \langle var \rangle = \langle expr \rangle \text{ in } \langle expr \rangle \\ &\mid \langle var \rangle \\ &\mid \text{pause } \langle expr \rangle \end{aligned}$$

2 Stage Types

$$\frac{\cdot}{\Gamma \vdash ()_{\sigma} : \sigma} \quad (1)$$

$$\frac{\Gamma \vdash e : \sigma}{\Gamma \vdash f \ e : \sigma} \quad (2)$$

$$\frac{\Gamma \vdash e : \sigma}{\Gamma \vdash \pi_i \ e : \sigma} \quad (3)$$

$$\frac{\Gamma \vdash e_1 : \sigma \quad \Gamma \vdash e_2 : \sigma}{\Gamma \vdash (e_1, e_2) : \sigma} \quad (4)$$

$$\frac{\Gamma \vdash e_1 : \sigma_1 \quad \Gamma, x : \sigma_1 \vdash e_2 : \sigma_2 \quad \sigma_1 \leq \sigma_2}{\Gamma \vdash \mathbf{let} \ x = e_1 \ \mathbf{in} \ e_2 : \sigma_2} \quad (5)$$

$$\frac{\Gamma(x) = \sigma}{\Gamma \vdash x : \sigma} \quad (6)$$

$$\frac{\Gamma \vdash e : \mathbb{1}}{\Gamma \vdash \mathbf{pause} \ e : \mathbb{2}} \quad (7)$$

3 Stage Splitting

3.1 Single Stage Conversion

3.2 Multiple Stage Splitting

$$\frac{\cdot}{\Gamma \vdash ()_1 \rightsquigarrow [(), x.x]} \quad (8)$$

$$\frac{\cdot}{\Gamma \vdash ()_2 \rightsquigarrow [(), ..()] } \quad (9)$$

$$\frac{\Gamma \vdash e \rightsquigarrow [p, x.r]}{\Gamma \vdash f \ e \rightsquigarrow [e, x.f \ r]} \quad (10)$$

$$\frac{\Gamma \vdash e \rightsquigarrow [p, x.r]}{\Gamma \vdash \pi_i \ e \rightsquigarrow [e, x.\pi_i \ r]} \quad (11)$$

$$\frac{\Gamma \vdash e_1 \rightsquigarrow [p_1, x_1, r_1] \quad \Gamma \vdash e_2 \rightsquigarrow [p_2, x_2, r_2]}{\Gamma \vdash (e_1, e_2) \rightsquigarrow [(p_1, p_2), l.(\mathbf{let} \ x_1 = \pi_1 \ l \ \mathbf{in} \ r_1, \mathbf{let} \ x_2 = \pi_2 \ l \ \mathbf{in} \ r_2)]} \quad (12)$$

$$\frac{\Gamma \vdash e_1 : \sigma_1 \quad \Gamma, x : \sigma_1 \vdash e_2 : \sigma_2}{\Gamma \vdash \mathbf{let} \ x = e_1 \ \mathbf{in} \ e_2 : \sigma_2} \quad (13)$$

$$\frac{\Gamma(x) = 2}{\Gamma \vdash x \rightsquigarrow [(), ..x]} \quad (14)$$

$$(15)$$