Definiciones

jueves, 6 de junio de 2024 10:00

Extensión de las expresiones y formas canónicas de lenguaje aplicativo eager

$\langle exp \rangle = \cdots \mid \mathrm{ref}\,\langle exp \rangle \mid \mathrm{val}\,\langle exp \rangle \mid \langle exp \rangle \coloneqq \langle exp \rangle \mid \langle exp \rangle =_{ref} \langle exp \rangle$

$\langle cnf \rangle = \cdots \mid \langle Rf \rangle$

Semántica operacional:

$$\Sigma = \bigcup_{D \subset_{fin} \langle Rf \rangle} D \to \langle cnf \rangle$$

$\Rightarrow \subseteq (\Sigma \times \langle exp \rangle) \times (\langle cnf \rangle \times \Sigma)$

r representa un elemento de $\langle Rf \rangle$

$\langle \sigma, z \rangle \Rightarrow \langle z, \sigma \rangle$

Si $\langle \sigma_0, e_0 \rangle \Rightarrow \langle \sigma_1, \lambda v.\, e_0' \rangle$, $\langle \sigma_1, e_1 \rangle \Rightarrow \langle z, \sigma_2 \rangle$ y $\langle \sigma_2, e_0'/[v : z] \rangle \Rightarrow \langle z', \sigma_3 \rangle$

entonces $\langle \sigma_0, e_0 e_1 \rangle \Rightarrow \langle z', \sigma_3 \rangle$

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Si $\langle \sigma, e_0 \rangle \Rightarrow \langle r, \sigma' \rangle$ y $\langle \sigma', e_1 \rangle \Rightarrow \langle z', \sigma'' \rangle$

entonces $\langle \sigma, e_0 \coloneqq e_1 \rangle \Rightarrow \langle z', [\sigma'' \mid r : z'] \rangle$

Si $\langle \sigma, e \rangle \Rightarrow \langle z, \sigma' \rangle$ entonces $\langle \sigma, \mathrm{ref}\, e \rangle \Rightarrow \langle r, [\sigma' \mid r : z] \rangle$

Donde $r \notin Dom(\sigma')$

Si $\langle \sigma, e \rangle \Rightarrow \langle r, \sigma' \rangle$ entonces $\langle \sigma, \mathrm{val}\, e \rangle \Rightarrow \langle \sigma' \, r, \sigma' \rangle$

Si $\langle \sigma, e_0 \rangle \Rightarrow \langle r_0, \sigma' \rangle$ y $\langle \sigma', e_1 \rangle \Rightarrow \langle r_1, \sigma'' \rangle$ entonces $\left\langle \sigma, e_0 =_{ref} e_1 \right\rangle \Rightarrow \langle \lfloor r = r' \rfloor, \sigma'' \rangle$

Semántica denotacional:

$V_{int} = \mathbb{Z}$

$V_{bool} = \{T, F\}$

$V_{fun} = [V \to D]$

$V_{tuple} = V^*$

$V = V_{int} + V_{bool} + V_{fun} + V_{tuple} + V_{ref}$

$\Sigma = \left\{\sigma \in \left(V_{ref} \times V\right) : \sigma \text{ es funcion}\right\}$

$D = (\Sigma \times V + \{\text{error}\} + \{typeerror\})_\perp$
$Env = \langle var \rangle \to V$

$err = \iota_\perp \iota_{\text{error}}$
$tyerr = \iota_\perp \iota_{\text{typeerror}}$
$\iota_{norm} : V \to D$

Si $f : V \to D$:

$f_*(\iota_{norm} v) = f\ v$
$f_*\ x = x$

Para $\theta \in \{inf, bool, fun, tuple, ref\}$:

$\iota_\theta : V_\theta \to V$
$\iota_{\underline{\theta}} = \iota_{norm} \circ \iota_\theta$

Si $f : \Sigma \times V_\theta \to D$

$f_\theta(\langle \sigma, \iota_\theta\ x \rangle) = f\ \langle \sigma, x \rangle$
$f_\theta(\langle \sigma, \iota_{\theta'}\ x \rangle) = tyerr$
$f_\theta\ x = x$

$f_{\theta *} = (f_\theta)_*$

$[\![\cdot]\!] \langle exp \rangle \to Env \to \Sigma \to D$
$[\![v]\!]\eta\sigma = \iota_{norm}\langle \sigma, \eta\ v \rangle$
$[\![e_0\ e_1]\!]\eta\sigma = \left(\lambda\langle \sigma', f \rangle .\ f_*([\![e_1]\!]\eta\sigma')\right)_{fun*}([\![e_0]\!]\eta\sigma)$
$[\![\lambda v.\ e]\!]\eta\sigma = \iota_{norm}\left\langle \sigma, \iota_{fun}(\lambda\langle \sigma', z \rangle\ [\![e]\!][\eta \mid v : z]\sigma') \right\rangle$

$$[\![\text{val}\ e]\!]\eta\sigma = \left(\lambda\langle \sigma', r \rangle .\begin{cases} r \in Dom(\sigma') & \to \quad \iota_{norm}\langle \sigma', \sigma'\ r \rangle \\ \text{si no} & \to \quad err \end{cases}\right)_{ref*}([\![e]\!]\eta\sigma)$$

$[\![\text{ref}\ e]\!]\eta\sigma = \left(\lambda\langle \sigma', z \rangle .\ \iota_{norm}\left\langle [\sigma' \mid r : z], \iota_{ref} z \right\rangle\right)_*([\![e]\!]\eta\sigma)$
Donde $r \in V_{ref} - Dom(\sigma')$

$$[\![e_0 \coloneqq e_1]\!]\eta\sigma = \left(\lambda\langle\sigma',r\rangle\,.\left(\lambda\langle\hat{\sigma},z\rangle\,.\,\iota_{norm}\left\langle[\hat{\sigma}\mid r\colon z],\iota_{tuple}\langle\,\rangle\right\rangle\right)_*([\![e_1]\!]\eta\sigma')\right)_{ref*}([\![e_0]\!]\eta\sigma)$$

$$[\![e_0 =_{ref} e_1]\!]\eta\sigma = \left(\lambda\langle\sigma',r_0\rangle\,.\,(\lambda\langle\hat{\sigma},r_1\rangle\,.\,\iota_{norm}\langle\hat{\sigma},\iota_{bool}(r_0 = r_1)\rangle)_{ref*}([\![e_1]\!]\eta\sigma')\right)_{ref*}([\![e_0]\!]\eta\sigma)$$

Azucares sintácticos:

$\text{skip} \equiv \langle\,\rangle$

$e_0; e_1 \equiv (\lambda v.\, e_1)e_0$

Donde $v \notin FV(e_1)$

$\text{newvar}\ v \coloneqq e_0\ \text{in}\ e_1 \equiv (\lambda v\,.\,e_1)(\text{ref}\ e_0)$

🤔: ¿No andaría sin el λv?

$\text{while}\ e\ \text{do}\ e' \equiv \text{letrec}\ f = (\lambda v\,.\,\text{if}\ e\ \text{then}\ (\lambda u\,.\,f\ v)e'\ \text{else}\ \langle\,\rangle)\ \text{in}\ f\ \langle\,\rangle$

1) 🛠️

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1. Evaluar (semántica operacional) las siguientes expresiones en el lenguaje aplicativo eager con referencias y asignación, en un entorno cualquiera η y un estado σ:
   a. $r := 1; 1 + \textbf{val}\ r \qquad (r \in \langle hrefcnf\rangle)$
   b. $\textbf{newvar}\ x := 1\ \textbf{in}\ ((1 + \textbf{val}\ x); x := 2 + \textbf{val}\ x)$
   c. **while True do skip**

a)

$r \coloneqq 1; 1 + \text{val}\, r$

$\equiv$

$(\lambda v\,.\,1 + \text{val}\, r)(r \coloneqq 1)$

$\langle \sigma, (\lambda v\,.\,1 + \text{val}\, r)(r \coloneqq 1)\rangle$

 $\langle \sigma, \lambda v\,.\,1 + \text{val}\, r\rangle \Rightarrow \langle \lambda v\,.\,1 + \text{val}\, r, \sigma\rangle$

 $\langle \sigma, r \coloneqq 1\rangle$

  $\langle \sigma, r\rangle \Rightarrow \langle r, \sigma\rangle$

  $\langle \sigma, 1\rangle \Rightarrow \langle 1, \sigma\rangle$

 $\Rightarrow \langle 1, [\sigma \mid r : 1]\rangle$

 $\langle [\sigma \mid r : 1], 1 + \text{val}\, r\rangle$

  $\langle [\sigma \mid r : 1], 1\rangle \Rightarrow \langle 1, [\sigma \mid r : 1]\rangle$

  $\langle [\sigma \mid r : 1], \text{val}\, r\rangle$

   $\langle [\sigma \mid r : 1], r\rangle \Rightarrow \langle r, [\sigma \mid r : 1]\rangle$

  $\Rightarrow \langle 1, [\sigma \mid r : 1]\rangle$

 $\Rightarrow \langle 2, [\sigma \mid r : 1]\rangle$

$\Rightarrow \langle 2, [\sigma \mid r : 1]\rangle$