

λ_{ref} Language Definition

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1 Overview

2 Syntax

The syntax of λ_{ref} is given below.

$$\begin{array}{l} v ::= () \\ | \quad n \in \mathbb{N} \\ | \quad b \in \mathbb{B} \\ | \quad x \\ | \quad \lambda x. e \end{array}$$
$$\begin{array}{l} e ::= v \\ | \quad e_1 \ e_2 \\ | \quad \text{let } x = e_1 \text{ in } e_2 \\ | \quad \text{if } e_1 \text{ then } e_2 \text{ else } e_3 \\ | \quad \text{ref } e \\ | \quad !e \\ | \quad e_1 := e_2 \end{array}$$

3 Small Step Semantics

$\frac{}{() \text{ val}} \text{ (unit)}$ $\frac{}{n \text{ val}} \text{ (int)}$ $\frac{}{b \text{ val}} \text{ (bool)}$ $\frac{}{\lambda x. e \text{ val}} \text{ (lam)}$ <p style="text-align: center;">values</p> $\frac{e_1 \mapsto e'_1}{\text{let } x = e_1 \text{ in } e_2 \mapsto \text{let } x = e'_1 \text{ in } e_2} \text{ (let-e)}$ $\frac{v \text{ val}}{\text{let } x = v \text{ in } e \mapsto e[v/x]} \text{ (let)}$ <p style="text-align: center;">let-expression</p>	$\frac{(e_1, \sigma) \mapsto (e'_1, \sigma')}{(\text{if } e_1 \text{ then } e_2 \text{ else } e_3, \sigma) \mapsto (\text{if } e'_1 \text{ then } e_2 \text{ else } e_3, \sigma')} \text{ (if)}$ $\frac{}{(\text{if true then } e_2 \text{ else } e_3, \sigma) \mapsto (e_2, \sigma)} \text{ (if-true)}$ $\frac{}{(\text{if false then } e_2 \text{ else } e_3, \sigma) \mapsto (e_3, \sigma)} \text{ (if-false)}$ <p style="text-align: center;">function application</p> $\frac{(e_1, \sigma) \mapsto (e'_1, \sigma')}{(e_1 \ e_2, \sigma) \mapsto (e'_1 \ e_2, \sigma')} \text{ (ap-l)}$ $\frac{v \text{ val} \quad (e_2, \sigma) \mapsto (e'_2, \sigma')}{(v \ e_2, \sigma) \mapsto (v \ e'_2, \sigma')} \text{ (ap-r)}$ $\frac{v \text{ val}}{((\lambda x. e) \ v, \sigma) \mapsto (e[v/x], \sigma)} \text{ (ap)}$ <p style="text-align: center;">if-expression</p>
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$$\frac{(e, \sigma) \mapsto (e', \sigma')}{(ref\ e, \sigma) \mapsto (ref\ e', \sigma')} \text{ (ref-e)}$$

$$\frac{v\ \mathbf{val} \quad l \notin \text{dom}(\sigma)}{(ref\ v, \sigma) \mapsto (l, \sigma[l \mapsto v])} \text{ (ref)}$$

$$\frac{(e, \sigma) \mapsto (e', \sigma')}{(!e, \sigma) \mapsto (!e', \sigma')} \text{ (deref-e)}$$

$$\frac{l\ \mathbf{val} \quad l \in \text{dom}(\sigma)}{(ll, \sigma) \mapsto (\sigma(l), \sigma)} \text{ (deref)}$$

$$\frac{(e_1, \sigma) \mapsto (e'_1, \sigma')}{(e_1 := e_2, \sigma) \mapsto (e'_1 := e_2, \sigma')} \text{ (set-l)}$$

$$\frac{l\ \mathbf{val} \quad (e_2, \sigma) \mapsto (e'_2, \sigma')}{(l := e_2, \sigma) \mapsto (l := e'_2, \sigma')} \text{ (set-r)}$$

$$\frac{l \in \text{dom}(\sigma) \quad v\ \mathbf{val}}{(l := v, \sigma) \mapsto ((), \sigma[l \mapsto v])} \text{ (set)}$$

references