

Featherweight Breeze: Step 1/4

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November 30, 2011

1 Syntax

Untyped lambda calculus with booleans and pairs.

c	$::=$		constants
		$()$	unit
		true	true
		false	false
t	$::=$		terms
		c	constant
		x	variable
		$\lambda x. t$	bind x in t abstraction
		$t_1 t_2$	application
		$\text{let } x = t_1 \text{ in } t_2$	bind x in t_2 let
		(t_1, t_2)	pairing
		$\text{fst } t$	first projection
		$\text{snd } t$	second projection
		$\text{if } t_1 \text{ then } t_2 \text{ else } t_3$	conditional
		(t)	S
v	$::=$		values
		c	constants
		$\langle \rho, \lambda x. t \rangle$	bind x in t closures
		(v_1, v_2)	pairs
ρ	$::=$		environments
		empty	
		$\rho, x : v$	
		(ρ)	S

2 Evaluation (Without IFC)

Big-step environmental semantics (no substitution).

$$\boxed{\rho \vdash t \Downarrow v}$$

$$\frac{}{\rho \vdash c \Downarrow c} \text{ EVAL_CONST}$$

$$\frac{\rho(x) = v}{\rho \vdash x \Downarrow v} \text{ EVAL_VAR}$$

$$\frac{}{\rho \vdash (\lambda x. t) \Downarrow \langle \rho, \lambda x. t \rangle} \text{ EVAL_ABS}$$

$$\frac{\begin{array}{l} \rho \vdash t' \Downarrow \langle \rho', \lambda x. t \rangle \\ \rho \vdash t'' \Downarrow v'' \\ (\rho', x : v'') \vdash t \Downarrow v \end{array}}{\rho \vdash t' t'' \Downarrow v} \text{ EVAL_APP}$$

$$\frac{\begin{array}{l} \rho \vdash t \Downarrow v \\ (\rho, x : v) \vdash t' \Downarrow v' \end{array}}{\rho \vdash \text{let } x = t \text{ in } t' \Downarrow v'} \text{ EVAL_LET}$$

$$\frac{\begin{array}{l} \rho \vdash t' \Downarrow v' \\ \rho \vdash t'' \Downarrow v'' \end{array}}{\rho \vdash (t', t'') \Downarrow (v', v'')} \text{ EVAL_PAIR}$$

$$\frac{\rho \vdash t \Downarrow (v', v'')}{\rho \vdash \text{fst } t \Downarrow v'} \text{ EVAL_FST}$$

$$\frac{\rho \vdash t \Downarrow (v', v'')}{\rho \vdash \text{snd } t \Downarrow v''} \text{ EVAL_SND}$$

$$\frac{\begin{array}{l} \rho \vdash t \Downarrow \text{true} \\ \rho \vdash t' \Downarrow v' \end{array}}{\rho \vdash \text{if } t \text{ then } t' \text{ else } t'' \Downarrow v'} \text{ EVAL_IF_TRUE}$$

$$\frac{\begin{array}{l} \rho \vdash t \Downarrow \text{false} \\ \rho \vdash t'' \Downarrow v'' \end{array}}{\rho \vdash \text{if } t \text{ then } t' \text{ else } t'' \Downarrow v''} \text{ EVAL_IF_FALSE}$$