

# Featherweight Breeze: Step 1/4

Cătălin Hrițcu, Benoît Montagu, Benjamin C. Pierce, and the Breeze team

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## 1 Syntax

Untyped lambda calculus with booleans and pairs.

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

## 2 Evaluation (Without IFC)

Big-step environmental semantics (no substitution).

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

$$\frac{}{\rho \vdash c \Downarrow c} \text{ EVAL\_CONST}$$

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

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

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

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

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

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

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

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

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