

$(\text{let } ([x \ 5])$
 $(\text{let } ([f \ (\lambda ()$
 $x)])$
 $(\text{let } ([x \ 2])$
 $(f)))$

$$\frac{c = \langle \vec{x}, e, \Gamma \rangle}{\Gamma \vdash \underbrace{\lambda \vec{x}. e}_{\text{ABS/CLO}} \Rightarrow c}$$

$$\Gamma \vdash e \Rightarrow c \quad \Gamma \vdash e_i \Rightarrow v_i, \dots$$

$$c = \langle x_1, \dots, e', \Gamma' \rangle$$

$$\alpha = \{x_1 \mapsto v_1, \dots\}$$

$$\alpha \Gamma' \vdash e' \Rightarrow v$$

APP-CLO

$$\Gamma \vdash @ e e_1, \dots \Rightarrow v$$

DYNAMIC 'SCOPE'

$$\Gamma \vdash \lambda \vec{x} e \Rightarrow \langle \vec{x}, e \rangle \quad \text{ABS/OPEN}$$

$$\Gamma \vdash e \Rightarrow \langle x_1, \dots, \text{body} \rangle \quad \Gamma \vdash e_i \Rightarrow v_i \dots$$

$$\alpha = \{x_i \mapsto v_i, \dots\}$$

$$\alpha \Gamma \vdash \text{body} \Rightarrow v$$

$$\Gamma \vdash @ e e_1 \dots \Rightarrow v \quad \text{APP/OPEN}$$

(let ([x 5])

(let ([f ($\lambda () x$)])

$\Rightarrow \langle (), x \rangle$

(let ([x 2])

(f)))

$\Rightarrow 2$

$\Gamma: \{x \mapsto 2\}$

RECURSION

$(\text{let}_{\text{rec}}([f \ (\lambda \ (x) \ \dots f \ \dots)])$



e)

RECURSIVE language

$e ::=$ $\text{recfun } f(x \dots) e \text{ in } e'$

The diagram shows the syntax $\text{recfun } f(x \dots) e \text{ in } e'$ enclosed in a green rounded rectangle. Inside this rectangle, a smaller green rounded rectangle highlights the sub-expression $f(x \dots) e$. Annotations with arrows point to various parts: an arrow points from the label 'id' to the identifier 'f'; another arrow points from the label 'formal' to the parameter list '(x ...)'; a third arrow points from the label 'procedure-body' to the expression 'e'; and a fourth arrow points from the label 'body of the recfun expression' to the expression 'e'.

$(\lambda (x \dots) e)$

@ e e ...

if e e e

Semantics

$$\alpha = \{f \mapsto c\}$$

$$c = \langle (x \dots), e, \Gamma' \rangle$$

$$\Gamma' = \alpha \Gamma$$

$$\Gamma' \vdash e' \Rightarrow v'$$

$$\Gamma \vdash \text{recfun } f (x \dots) e \text{ in } e' \Rightarrow v'$$

RECFUN

(recfun

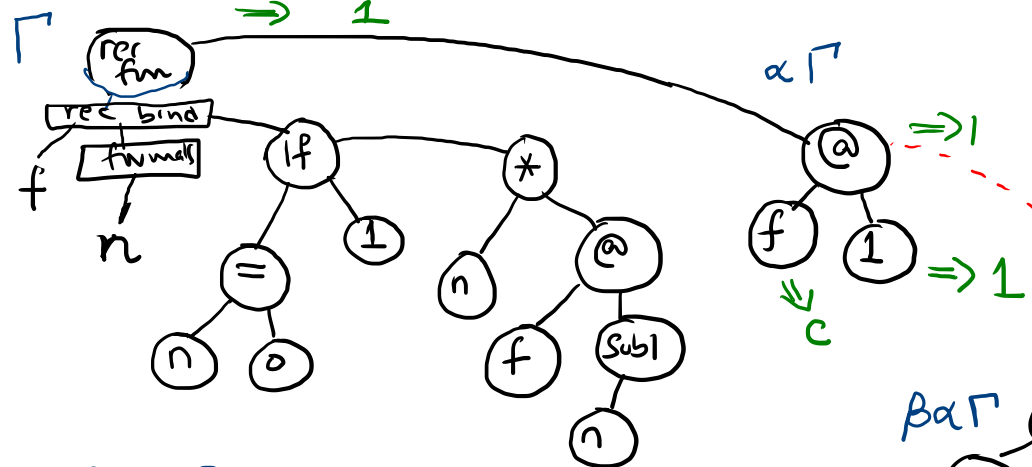
f (n)

(if (= n 0)

1

(* n (f (sub1 n))))

(f 1))



$$\alpha = \{f \mapsto c\}$$

$$C = \langle (n), \text{if} \dots, \alpha \Gamma \rangle$$

$$\beta = \{n \mapsto 1\}$$

$$\gamma = \{n \mapsto 0\}$$

