3~1/   C :=  ▩  |  (if C  e e)
              |  (if  e  C  e)
              |  (if  e  e  C)
              |  (e ...  C  e ... )

(if false  (+1 1) 3)

(if false  ▨  3) [ (+ 1 1) ]

                ⇓

(if false   2   3)

3-2/  Evaluation   contexts ,  $E :=$

$$E := \square \;\mid\; (\text{if} \quad E \quad e \quad e)$$
$$\mid\; (v \; \ldots \; E \quad e \ldots )$$

step    $E[ (\text{if false} \quad e_t \quad e_f)] = E[e_f]$

step    $E[ (\text{if} \quad v \text{\&false} \quad e_t \quad e_f)] = E[e_t]$

step    $E[ (p \; v \ldots)] = E[ \delta(p, v \ldots)]$

interp $e$ = case (find-redex $e$) of

         false $\rightarrow$ $e$

         $(E, r) \rightarrow$ let $r' =$ step $r$ in

               interp $E[r']$

3-3/  find-redex : $e \Rightarrow$ false   or   $(E \times e)$

fr   v   = false

fr$^{ee}$(if $e_c$  $e_t$  $e_f$) =

   case  fr $e_c$  of

      false  $\rightarrow$ ( ▮ , e)

      (E, r) $\rightarrow$ ( if  E   $e_t$   $e_f$  ,  r)

fr  e@ ( v ... ) = ( ▮ , e)

fr  e@ (v ... $e_0$  $e_m$ ...) =

   let (E, r) = fr  $e_0$  in

   ( (v ... E  $e_m$ ...) ,  r)

**3-4]** fr (+ 1    (* 2 3)) =

$\qquad$ ( (+ 1 ▨), (* 2 3)))

$\quad$ fr  (* 2 3)  = (▨, (* 2 3))


$\quad$ step  (* 2 3)  =  $\delta(*, 2, 3)$ = 6

$\quad$ plug (+ 1 ▨) 6  = (+ 1 6)

$\quad$ fr (+ 1 6)  = (▨, (+ 1 6))

$\quad$ step (+ 1 6)  = 7

$\quad$ plug ▨ 7 = 7

$\quad$ fr  7  = false  $\rightarrow$ ⑦

big-program $[$ (+ 1 (* 2 3)) $]$

machine model

lang e $\xrightarrow{\text{inject}}$ machine st

$\downarrow$ step           $\downarrow$
                   $\downarrow$

$lang$ e'                    $\downarrow$

          $\xleftarrow{\text{extract}}$     machine st'
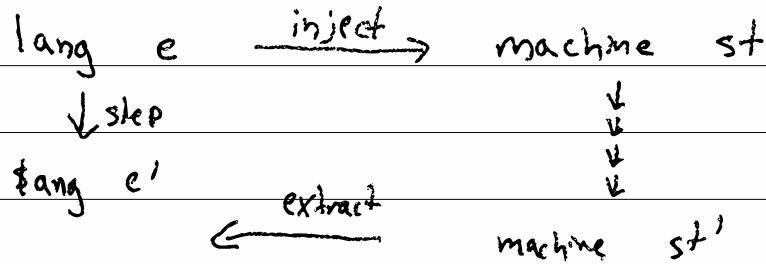
## 3-b) $CC_0$

$$st = \langle e, E \rangle \qquad\qquad st \mapsto st$$

$$\text{inject } e = \langle e, \text{hole} \rangle$$

$$\text{extract } \langle e, E \rangle = E[e]$$

[1] $\langle \text{if } e_c \; e_t \; e_c, E \rangle \mapsto \langle e_c, E[\text{if } \blacksquare \; e_t \; e_f] \rangle$

[2] $\langle \text{false}, E[\text{if } \blacksquare \; e_t \; e_c] \rangle \mapsto \langle e_f, E \rangle$

[3] $\langle v, E[\text{if } \blacksquare \; e_t \; e_c] \rangle \mapsto \langle e_t, E \rangle$

[4] $\langle e_0 \; e_m \ldots, E \rangle \mapsto \langle e_0, E[(\blacksquare \; e_m \ldots)] \rangle$

[5] $\langle v, E[(v_b \ldots \text{hole } e_0 e_a \ldots)] \rangle \mapsto \langle e_0, E[(v_b \ldots v \; \blacksquare \; e_{a_n})] \rangle$

[6] $\langle v_n, E[(p, v_b \ldots \text{hole})] \rangle \mapsto \langle \delta(p, v_b \ldots v_n), E \rangle$

3-7/ (+ 1 (x 2 3)) $\downarrow$ inject

< (+ 1 (x 2 3)), ☐ > $\downarrow$ 5

< +, ☐[(☐ 1 (x 2 3))] > $\downarrow$ 5

< 1, ☐[(+ ☐ (x 2 3)] ] > $\downarrow$ 5

< (x 2 3), ☐[(+ 1 ☐)] > $\downarrow$ 4

< x, ☐[+ 1 ☐][☐ 2 3] > $\downarrow$ 5

< 2, ☐[+ 1 ☐][x ☐ 3] > $\downarrow$ 5

< 3, ☐[+ 1 ☐][x 2 ☐] > $\downarrow$ 6     $\delta(x, 2, 3) = 6$

< 6, ☐[+ 1 ☐] > $\downarrow$ 6     $\delta(+, 1, 6) = 7$

< 7, ☐ > $\downarrow$ extract

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