

19-1/

$I \text{ (assign } x \text{ } e) \text{ } r \text{ } p \text{ } k \text{ } \sigma =$

if $p(x) = \text{Var}(x', op, s, lx')$

if $\text{ref} \neq s$, then

$I \text{ } e \text{ Effect } r \text{ } p \text{ } k \text{ } \sigma$

o.w.

$I \text{ } e \text{ Value } r \text{ } p \text{ } k, \sigma$

$k, e' \sigma_1 = k \text{ (seg (assign } x' \text{ } e') \text{ (const } c) \text{ } \sigma_2$

$c = \text{true}$ if $r = \text{Test}$ o.w. $c = \text{void}$

$\sigma_2 = \sigma_1 [lx' \mapsto \{\text{assign}\} \cup \sigma_1(lx')]$

$I \text{ (call } e_1 \text{ } e_2) \text{ } r \text{ } p \text{ } k \text{ } \sigma =$

$I \text{ } e_1 \text{ } r_1 \text{ } p \text{ } k_1 \text{ } \sigma_1$

$r_1 = \text{App}(op, r, lr_1)$

$op = \text{Opnd}(e_2, p, le_2)$

$\sigma_1 = \sigma [le_2 \mapsto \text{unvisited}, lr_1 \mapsto \emptyset]$

$k, e' \sigma_2 =$ if $\sigma_2(lr_1) \ni \text{inlined}$ then

$k \text{ } e' \text{ } \sigma_2$

o.w. $\text{visit}(op, \text{Value}, k_2, \sigma_2)$

$k_2 \text{ } e'_2 \text{ } \sigma_3 = k \text{ (call } e'_1 \text{ } e'_2) \text{ } \sigma_3$

$\text{visit}(\text{Opnd}(e, p, le), r, k, \sigma) =$

if $\sigma(le) = \text{unvisited}$ then $I \text{ } e \text{ } r \text{ } p \text{ } k, \sigma$

$k, e' \sigma' = k \text{ } e' \text{ } \sigma [le \mapsto e']$

o.w. $k \text{ } \sigma(le) \text{ } \sigma$

19-2/

$I \text{ (primref } p) \ r \ p \ k \ \sigma =$

if $r = \text{Test}$ then $k \text{ (const true)} \ \sigma$

if $r = \text{Effect}$ then $k \text{ (const void)} \ \sigma$

if $r = \text{Value}$ then $k \text{ (primref } p) \ \sigma$

if $r = \text{App}(op, r_1, l_r)$ then $\text{fold (primref } p) \ r \ p \ k$

$\text{fold (primref } p) \ \text{App}(op, r_1, l_r) \ p \ k \ \sigma =$

$\text{visit}(op, \text{Value}, k_1, \sigma)$

$k_1 \ e' \ \sigma_1 = \text{if result}(e'_1) = (\text{const } c) \text{ and } \boxed{p(c) = c'} \text{ where the / c.t. e. happens}$
 $k \text{ (const } c') \ \sigma_2$

$\sigma_2 = \sigma_1 [l_r \mapsto \{\text{inlined}\} \cup \sigma_1(l_r)]$

O.w. $k \text{ (primref } p) \ \sigma_1$

$I \text{ (lambda } x \ e) \ r \ p \ k \ \sigma =$

if $r = \text{Test}$, $k \text{ (const true)} \ \sigma$

if $r = \text{Effect}$, $k \text{ (const void)} \ \sigma$

if $r = \text{App}(op, r_1, l_r)$, $\text{fold (lambda } x \ e) \ r \ p \ k \ \sigma$

if $r = \text{Value}$, $I \ e \ \text{Value } p_1 \ k_1 \ \sigma_1$

x' and $l_{x'}$ are fresh

$\hat{x}' = \text{Var}(x', \text{null}, \sigma(l_x), l_{x'})$

$p_1 = p [x \mapsto \hat{x}']$

$\sigma_1 = \sigma [l_{x'} \mapsto \emptyset]$

$k_1 \ e' \ \sigma_2 = k \text{ (lambda } x' \ e') \ \sigma_2$

19-3/

fold $(\lambda x e). \text{App}(\text{op}, r_1, |r) \rho k \sigma =$

$I \in r_1 \rho_1 k_1 \sigma_1$

$\hat{x} = \text{Var}(x, \text{null}, s, |x)$ x' and $|x'$ are fresh

$\hat{x}' = \text{Var}(x', \text{op}, \sigma(|x), |x')$

$\rho_1 = \rho [\hat{x} \mapsto \hat{x}']$

$\sigma_1 = \sigma [|x' \mapsto \emptyset]$

$k_1 \ e' \ \sigma_2 = \text{if } \text{ref} \notin \sigma_2(|x') \text{ and } \text{assign} \notin \sigma_2(|x')$

$\text{visit}(\text{op}, \text{Effect}, k_2, \sigma_2)$

$\text{if } \text{ref} \notin \sigma_2(|x') \text{ and } \text{assign} \in \sigma_2(|x')$

$\text{visit}(\text{op}, \text{Effect}, k_3, \sigma_2)$

$\text{o.w. } \text{visit}(\text{op}, \text{Value}, k_3, \sigma_2)$

$k_2 \ e' \ \sigma_3 = k \ (\text{seq } e' \ e') \ \sigma_3 [|r \mapsto \{\text{ref}\} \cup \sigma_3(|r)]$

$k_3 \ e' \ \sigma_3 = k \ (\text{call } (\lambda x' e') e') \ e' \ \sigma_3$

$I \ (\text{ref } x) \ r \ \rho \ k \ \sigma =$

$\text{if } r = \text{Effect} \ , \quad k \ (\text{const void}) \ \sigma$

$\text{if } \rho(x) = \text{Var}(x', \text{op}, s, |x')$

$\text{and } \text{op} = \text{null} \ \text{OR } \text{assign} \in s \text{ then } k \ (\text{ref } x') \ \sigma_1$

$\sigma_1 = \sigma [|x' \mapsto \{\text{ref}\} \cup \sigma(|x')]$

$\text{o.w. } // \text{op is n't null (so we know what we are)}$

$\text{visit}(\text{op}, \text{Value}, k_1, \sigma)$

$k_1 \ e \ \sigma_2 = \text{copy}(\rho(x), \text{result}(e), r, k, \sigma_2)$

9-4/

copy (Var (x', op, s, l x') , e , r , k , σ) =

1) if $e = (\text{const } c)$, $I \in r \ P \ k \ \sigma$

2) if $e = (\text{ref } x_i)$ and assign & s,
 $\hat{x}_i = \text{Var} (x_i , op_i , s_i , l x_i)$, $k (\text{ref } x_i) \ \sigma$

3) if $r = \text{App} (op, r_1, l r)$
and $e = (\text{primref } p)$ or $e = (\text{lambda } x_i . e_i)$
then fold $e \ r \ p \ k \ \sigma$

4) if $r = \text{Value}$ and $e = \text{primref } p$
 $k (\text{primref } p) \ \sigma$

5) if $r = \text{Test}$ and $e = \text{primref}, \text{lambda}, \text{assign}$
 $k (\text{const true}) \ \sigma$

6) $k (\text{ref } x_i) \ \sigma_i$ where $\sigma_i = \sigma [x_i \mapsto \text{ref } \sigma(k_i)]$