7-1

$R_e = \ldots \mid (\text{if } e\ e\ e) \mid \#t \mid \#f$

$\mid (\text{and } e\ e) \mid (\text{or } e\ e) \mid (\text{not } e)$

$\mid (\text{cmp } e\ e)$

$\text{cmp} = \text{eq} \mid \text{lt} \mid \text{gt} \mid \ldots$

$E[(\text{if } \#t\ e_1\ e_2)] \Rightarrow E[e_1]$

$\#f \qquad \Rightarrow e_2$

$E = \ldots \mid (\text{and } E\ e) \mid (\text{and } V\ E)$

$(+\ \#t\ 3) \Rightarrow \bot$

$(+\ x\ 3)$

$T = \text{Int} \mid \text{Bool}$

$Ty(: R \Rightarrow T$ (or crash) (put before/after uniquify)

$Ty(: \text{env}(\text{var} \to \tau)\ R \to \tau$

$T(\Gamma, \text{int}) = \text{Int}$

$T(\Gamma, \#t) = \text{Bool}$

$T(\Gamma, (+\ e_l\ e_r)) = \text{if } T(\Gamma, e_l) = \text{Int} \text{ \& } T(\Gamma, e_r) = \text{Int},$

then Int o.w. error

$T(\Gamma, (\text{cmp } e_l\ e_r)) = T(\Gamma, e_l) = \text{Int} \wedge T(\Gamma, e_r) = \text{Int} \wedge \text{Bool}$

$T(\Gamma, x) = \Gamma(x)$

$T(\Gamma, \text{let}(x, xe, be)) =$

$\quad T(\Gamma[x \mapsto T(\Gamma, xe)], be)$

$T(\Gamma, (\text{if } e_c\ e_t\ e_f)) =$

$\quad T(\Gamma, e_c) = \text{Bool}$

$\quad T(\Gamma, e_t) = T(\Gamma, e_f)$

$\quad T(\Gamma, e_t)$

7-2/

flatten : $R^{+}.p \Rightarrow C.p$

$R.p$ = (program e)

$C.p$ = (program vs ss a)

$R^{+}.p$ = (program t e)

$C.p$ = (program vs ss a t)

$C.a$ = int | var

$C.e$ = (read) | (+ a a) | (- a) | (and | (or | (cmp | (not

$C.s$ = (set! x e) | (if (cmp a a) $\vec{s}$ $\vec{s}$) [hard]

(if a $\vec{s}$ $\vec{s}$) [easy]

(eq 1 a)

easy: flatten(if(e_c, e_t, e_f))

$\langle vs_c, ss_c, a_c \rangle$ = flatten(e_c)

$\langle vs_t, ss_t, a_t \rangle$ = flatten(e_t)

$\langle vs_f, ss_f, a_f \rangle$ = flatten(e_f)

let vif be a new variable

$\langle$ vif ++ vs_c ++ vs_t ++ vs_f ,

ss_c ++ (if (eq 1 a_c)

(ss_t ++ (set! vif a_t))

(ss_f ++ (set! vif a_f))) ,

vif $\rangle$

hard: $flatten^{HC}$: $R^{+}.e \Rightarrow C.p^{HC}$

$C.p^{HC}$ = (program vs ss a Maybe(cmp a a))

fHC(Int) = $\langle \ldots, 1 \rangle$

fHC(#t) = $\langle \ldots$, eq 1 1$\rangle$

fHC(#f) = $\langle \ldots$, eq 1 0$\rangle$

fHC(eq e_1 e_2) = $\langle$, ~~[illegible]~~, ~~[illegible]~~, v_{eq}, eq a_1 a_2 $\rangle$

vs = v_{eq} ++ vs_1 ++ vs_2

ss = ss_1 ++ ss_2 ++ (set! v_{eq} (eq a_1 a_2))