Part of proof, g1 closure crt.

show $(n_2, (reg_1[pc \mapsto PP(c_{g1})], ms, [illegible])) \in O(W_1)$

looking at malloc r_2 1 w/ c_n next

lemma malloc works:

All the assumptions are satisfied ($ms_1^* = ms_1' \uplus ms_{malloc}$ where

$ms'_{malloc} :_n [0 \mapsto W_1(0)]$)

So let $n_2' \leq n_2 - 1$, $\iota_{malloc} \sqsupseteq^{pub} W_1(0)$ be given

- $ms''_{malloc} :_n [\iota_{malloc}]$
- $ms''_{malloc} \uplus ms_1' : W_1[0 \mapsto \iota_{malloc}]$

$\cdot\ reg_1'(r) = \begin{cases} c_n & pc = r \\ ((rw, global), b_{ex}, e_{ex}, b_{ex}) & r_1 = r \\ reg_1(r) & r \notin RN_x \cup \{pc, r_1, r_2\} \end{cases}$ $= c_x$

- $e_{ex} - b_{ex} = 0$
- $ms_{ex}(b_{ex}) = 0$

and show

$(n_2', (reg_1', ms_1' \uplus ms''_{alloc} \uplus ms_{ex})) \in O(W_1[\iota_{malloc}])$

Use anti-red lemma. Given ms_f

$(reg_1', ms_1' \uplus ms''_{alloc} \uplus ms_x' \uplus ms_f)$

$\rightarrow^3 (reg_1'', ms_1' \uplus ms''_{alloc} \uplus ms_x'' \uplus ms_f)$

where

$reg_1''(r_3) = c_{f4} = ((rx, global), g1\text{-}start, 4f, f4)$

$reg_1''(r) = reg_1'(r) \quad r \neq pc, r_3$

$(reg_1'', ms_1' \uplus ms_{alloc} \uplus ms_x)$ is looking at crtcls $[(x, r_2)]$ r_3 w/ c_n next

Show

$(n_2', (reg_2'', ms_1' \uplus ms'_{alloc} \uplus ms_x'')) \in O(W_1[\iota_{malloc}][\iota_x])$

Use crtcls correctness lemma.

- $ms_1' \uplus ms_{alloc} \uplus ms_x : W_1[\iota_{malloc}][\iota_x]$ b.c. and $ms_x :_n [\iota_x]$ and lemma w/ mem sat and disj union.
- The remaining things are given by assump remains to show Hyp-Cont.

assume

- $n_2'' \leq n_2' - 2$
- $\iota'_{malloc} \sqsupseteq^{pub} W_1 \ldots$ (0)
- $ms'''_{alloc} : [\iota'_{malloc}]$
- $reg_1'''(r') = \begin{cases} c_n' & pc \\ ((e, global), b_{cls}, e_{cls}, b_{cls} + 2) = c_{cls} & r_1 \\ reg_3''(r') & \neq pc, r_1 \end{cases}$
- $ms_{cls} = ms_{act} \uplus ms_{env}$
- $c_{env} = ((rw, global), b_{env}, e_{env}, b_{env})$

- $ms_{am}(b_{am}) = c_x$
- Hyp-Act

...

Show

$(n_2'', (reg_1''', ms_1' \uplus ms_x \uplus ms_{alloc}''' \uplus ms_{cls}))$
$\in O(W, L c_x] L O \sim s c_{alloc}'])$

Use anti-reduction lemma ~~and stack~~ given ms$_f'$ lemma

$(\ldots, reg_1''', ms_x \uplus ms_{alloc}'' \uplus ms_{cls} \uplus ms_f'$
$\longrightarrow (reg_1'''', ms_x \uplus ms_{alloc}'' \uplus ms_{cls} \uplus ms_f')$

where

$reg_1''''(pc) = \mathrm{incPP}(reg_1(r_0))$
$reg_1''''(r_0) = reg_1(r_0)$
$reg_1''''(r_1) = c_{cls}$

Show

$(n_2''', (reg_1''', ms_x \uplus ms_{alloc}'' \uplus ms_{cls} \uplus ms_f')$
$\in O(W, L c_{alloc}''] L c_x] L c^{sta}(\ldots, ms_{am} \uplus ms_{cls})]$