7-3 $\langle (+\ ((\lambda x.x)\ 3)\ ((\lambda y.y)\ 4)),\ [] \rangle$

$4 \mapsto_{scc} \langle ((\lambda x.x)\ 3),\ (+\ []\ ((\lambda y.y)\ 4)) \rangle$

$1 \mapsto_{scc} \langle (\lambda x.x),\ (+\ ([]\ 3)\ ((\lambda y.y)\ 4)) \rangle$

$2 \mapsto_{scc} \langle 3,\ (+\ ((\lambda x.x)\ [])\ ((\lambda y.y)\ 4)) \rangle$

$3 \mapsto_{scc} \langle x[x \leftarrow 3] = 3,\ (+\ []\ ((\lambda y.y)\ 4)) \rangle$

$5 \mapsto_{scc} \langle ((\lambda y.y)\ 4),\ (+\ 3\ []) \rangle$

$1 \mapsto_{scc} \langle (\lambda y.y),\ (+\ 3\ ([]\ 4)) \rangle$

$2 \mapsto_{scc} \langle 4,\ (+\ 3\ ((\lambda y.y)\ [])) \rangle$

$3 \mapsto_{scc} \langle y[y \leftarrow 4] = 4,\ (+\ 3\ []) \rangle$

$6 \mapsto_{scc} \langle \delta(+, 3, 4) = 7,\ [] \rangle$

$\langle 7,\ [] \rangle$

↙ suppose

$(+\ (+\ ((\lambda x.x)\ 3)\ ((\lambda y.y)\ 4))\ 7)$

$\langle 7,\ (+\ []\ 7) \rangle$

$\langle 7,\ (+\ 7\ []) \rangle$

$\langle 14,\ [] \rangle$

9-1

ISWIM => standard reduction => CC => SCC
=> CK => CEK

CK = Control String, K = → C stack
                       ⇒ PL kontinuation

E =	K = mt	E
(E N)	<ar, N, K>	E[([] N)]
(V E)	<fn, V, K>	E[(V [])]
(o^n V ... E N ...) ①	<pr, <V ...>, <N ...>, o, K>	E[(o V ... [] N ...)]

$eval_{ck}(M) = \langle M, mt \rangle \longmapsto_{ck}$

$\langle (M\ N), K \rangle \longmapsto_{ck} \langle M, \langle ar, N, K \rangle \rangle$

$\langle V, \langle ar, N, K \rangle \rangle \longmapsto_{ck} \langle N, \langle fn, V, K \rangle \rangle$

$\langle V, \langle fn, \lambda x.M, K \rangle \rangle \longmapsto_{ck} \langle M[x \leftarrow V], K \rangle$

$\langle call, K \rangle$

$\langle (o\ M\ N \ldots), K \rangle \longmapsto_{ck} \langle M, \langle pr, o, \langle\rangle, \langle N \ldots \rangle, K \rangle \rangle$

$\langle V, \langle pr, o, \langle V' \ldots \rangle, \langle M\ N \ldots \rangle, K \rangle \rangle$

$\longmapsto_{ck} \langle M, \langle pr, o, \langle V' \ldots, V \rangle, \langle N \ldots \rangle, K \rangle \rangle$

$\langle V, V' \ldots \rangle$

$\langle b_n, \langle pr, o^n, \langle b_{n-1} \ldots b_1 \rangle, \langle\rangle, K \rangle \rangle$

$\longmapsto_{ck} \langle \delta(o^n, b_1, \ldots, b_n), K \rangle$

Thm: $eval_{ck} = eval_{SCC}$?

CEk — Control, Environment, Kontinuation

$\langle V, \langle fn, \lambda X.M, k\rangle\rangle \longmapsto_{Ck} \langle M[X \leftarrow V], k\rangle$

$\langle V, \langle fn, \lambda X.M, \quad , k\rangle\rangle \longmapsto_{CEk} \langle M, \mathcal{E}[X \leftarrow V], k\rangle$

$\langle 7, \langle fn, \lambda X.X, mt\rangle\rangle \longmapsto_{Ck} \langle X[X \leftarrow 7], mt\rangle$
$= \langle 7, mt\rangle$

$\mathcal{E} = \bullet$

$\langle X, \mathcal{E}, k\rangle \longmapsto_{CEK} \langle \mathcal{E}(x), \mathcal{E}, k\rangle$ $\qquad \mathcal{E}[X \leftarrow V]$

$\langle (M\ N), \mathcal{E}, k\rangle \longmapsto_{CEK} \langle M, \mathcal{E}, \langle ar, N, \mathcal{E}, k\rangle\rangle$

① $\langle V, \mathcal{E}, \langle ar, N, \mathcal{E}', k\rangle\rangle \longmapsto_{CEK} \langle N, \mathcal{E}', \langle fn, V, \mathcal{E}, k\rangle\rangle$

↳ $\lambda X.Y \ldots [Y \leftarrow 11]$

$((\lambda X. \bullet [X \leftarrow 8])[X \leftarrow 7]$

$(\lambda X.$ ↙
$X)$
$7)\ 8)$

③ $\langle V, \mathcal{E}, \langle fn, \lambda X.M, \mathcal{E}', k\rangle\rangle \longmapsto_{CEK}$
$\langle M, \mathcal{E}'[X \leftarrow V], k\rangle$

$V_{Ck} = \lambda X.M$	b ↙ a closure
$V_{CEk} =$ ~~b~~	$\langle clo, \lambda X.M, \mathcal{E}\rangle$

$\langle \lambda X.M, \mathcal{E}, k\rangle \longmapsto_{CEK} \langle \langle clo, \lambda X.M, \mathcal{E}\rangle, \mathcal{E}, k\rangle$

①' $\ldots \longmapsto_{CEk} \langle N, \mathcal{E}', \langle fn, V, k\rangle\rangle$

②' $\langle V, \mathcal{E}, \langle fn, \langle clo, \lambda X.M, \mathcal{E}'\rangle, k\rangle\rangle$
$\longmapsto_{CEk} \langle M, \mathcal{E}'[X \leftarrow V], k\rangle$