```
4-3
                                                          evalv: M -> answers = A
                                                          evalv(m) 5 b if M=v b

= 2 'fon ; f M=v \(\lambda \times \
                                                           answers = V (constant, function, or variable)
                                                                                                                                           b (XXIM)
                                                                                                                                                                                           V
                                                                                                                                                                   function X E FV (M)
                                                                      A = B v Elfun 3
                                                       Is evalv total or partial?
                                                                  pantial: M = V X

M = V (b M)

= V (on b ... (1 xin) b'...)

"Stuck" (whe for "error")
                                                              never Arish = "liverge" (infinite loop)
                               \Omega = \left( \left( \lambda_{X_{1}} \left( x \times x \right) \right) \left( \lambda_{Y_{1}} \left( y y \right) \right) \right) \qquad M \quad B \quad M
                                                              ((2 y, (y y)) (2 y, (y y)))
                                                     Y = the Y combinator (or fixed-point operator)
                                                     Y_{V} = (\lambda f, (\lambda x, ((\lambda g, (f (\lambda x, ((g g) x)))))
                                                                                                                                            ( \langle g, (f(x, ((gg) x))), (f(x, ((gg) x))), (f(x, ((gg) x))) ) )
                                          Theorem: If K = JZ, JX, L then (K(YvK)) = v(YvK))

Y_v K \Rightarrow_v ... V[f \leftarrow K] = V
(It, It, DX) YV X XX, ((KV)X)
                                                                                              = \lambda x_1 (([\lambda \overline{z}_1 \lambda x_1 L] \vee) x)
\longrightarrow \lambda x_1 L [\overline{z}_{\leftarrow} V] [X \leftarrow x]
(K (YUK))
                                                                                                                              = XX, L[ZEV]
```

4-4	TC M=V, XX,N,
	$((\lambda X, N) M) = V N [X \leftarrow M] (B)$
моба delarativo и дерга порта разполога на града в се те-т	
	Justifies inlining (pg 51)
2-1	evalu is a partial function
	(+ (+ 12) (+ 3 4))
	(+ 3 (+34)) (+ (+12) 7)
	( ++ i / i ++ )
	Vm, A, Az. evalv (M) = A. 1 evalv (M) = Az
	$A_1 = A_2 = X$
	A. b mid a X, M = V b
	FOOT   The state of the state o
	If M=N, FL, M>>> L and N>>> L.
	M
	D> /K Consistency
	L T
	Church-Rosser
	If L->> M and L->> N, 7K,
accommon acc	$M \rightarrow N  \text{and}  N \rightarrow N  K$
	B-CiR was the For
	'K
Note that the foreign and the substitute of the	

5-7	$((\lambda_{x_i}(x_i)(\lambda_{y_i}((\lambda_{x_i}x_i)(\lambda_{x_i}x_i))))$
	$((\lambda y, ((\lambda x, x)(\lambda x, x))))$ $((\lambda y, ((\lambda x, x)(\lambda x, x)))$ $((\lambda y, ((\lambda x, x)(\lambda x, x))))$ $((\lambda y, ((\lambda x, x)(\lambda x, x))))$ $((\lambda y, ((\lambda x, x)(\lambda x, x))))$
	$M \subset \mathcal{N} M$ $A : (o^n b_1 \dots b_n) \subset \mathcal{N} \delta(o^n, b_1, \dots, b_n)$
	$\beta_{v}': ((\lambda \times M) u) \longrightarrow M'[x \leftarrow v.]$
	if Mezmi and U Cov V'
gamentaking di kalan (C.P. (C.P.)	(MN) CON (M'N') IS MOONING AND NOTON'
alakatakin sulatan perunangga papanggan kelalah Sibb Si Peruna, perunandapan kelalah kelalah Sibb Si Peruna,	$(\lambda X, M) \longrightarrow (\lambda X, M')$
es en grande de la companya del companya de la companya del companya de la companya del la companya de la compa	(on M Mr) (on M', M'n)
	7
	Shibstitution Lemma:
	If M Cov M' and N Cov N', then
	m[x < n] < m'[x < n']
nadalalamoolilalalahahagayayneen seekas kalkunankillä (läälä), viin 1941 osa en en	M = (+ (+3 10) (x ? s)) M' = (+ 13 (x ? s))
kull colleger gegengagengagen skale forske kelle skale skale forske forske forske forske forske forske forske	$N = (\lambda y, (+ \xi + (+ 2 \gamma) y))$
	$N' = (\lambda y, (+ 6 y))$
	[(+ (+310)
englessengskappspappspappspappspappspappspappspap	((dy, (+ (+24)y))5))
gallagen auropiinista valitatis austropoiste en president et austri ethe ethe ethe ethe ethe ethe ethe eth	(+ 13 ((Ay, (+ 6 y) 5))
uale dans et le red des la réd de l'Arthur (sign, au de dans qu'il en repaire, ce au mé resine de l'arthur (si	

5-3 Observational Eguivalence				
What does = mean?  5 ym (refl+trans (compatible (v = AuBv)))				
sym ( real + trans ( compatible ( V = 12 U/SV)))				
Want: do these programs do the same thing?				
slow fast verl verZ platform/ platformZ				
Slow fast verl ver? platform! platform?  ( proof, use fast) check. porting  more clear traks				
more clear traks				
(+34) = 7 FR (1x, factorial recursive).				
=v. IF()x, i terative factoral)				
× no?				
(h, 12) Amerges to (h(12 12)) diverges				
= 5 turn the program M into a math function				
Todenotational semantics (Scatt Pomain Theory)				
() 3x. (FRx) \$ (IFx) isont vs yeart				
(a a > bool) (La) > (La)				
$\exists cmp, 1, isort(Lmp, 1) = gsort(conp, 1)$				
F and G				
$(3) \qquad X \rightarrow (Y \rightarrow Z) \qquad FX = 6 \times$				
$\exists x, \exists y ((                                $				
Context is a program with a HOLE				
0 \$ \$ C = (C] x) (C] 7)				
(3) $C = ((C7 \times) y)$ ((C7 10) 1)				

C = CI(There's nothing for X or b) 5-4 1 (1 X, C) 1 (Cm) (M C) 1 (on M ... ( M ...) C[N] to mean "fill the hole in C with N" CIENI = N (1 XI C)[N] = (1X, C[N]) // N can mention X (( M)[N] - ( [[N] M) (MC)[N] = (M C[N]) (on M. .. C M ... ) [N= (on M ... C[N] M ...)  $C = \lambda X, CJ$  N = X  $C[N] = \lambda X, X$ \* Xxx \* Xyx X M > W ICE FC. M=C[M'] and N=C[N'] and M' v N'  $\rightarrow \omega = \rightarrow v$  M = (x (+34)) N = (x 7)C= (x []) M'= (+34) N'=7 MZVN (Mis observationally equivalent to W) iff. Yc. evil(C[M]) = evalu (C[N]) wants: 4m. M 2 M if L ZV M and MZV N, L ZV N (equivalence) LZVM -> MZVL If MZVN, HC. C[M] ZV C[N]

5-5 Soundness + Incompleteness	
If M=VN, them M2VN,	(soundness)
But, MZVN > Hat M = N	(incompleteness)
V	
(1x, 12) 2v (1x, (12 2))	=
but	
(4x, 12) # (4(12 -12))	
(n n) (100	(p())(7) 2 loup()
<b>↓</b>	
n (etu): (1x, Mx) = M	
(=E] fon dim	
C = EJ for $9%$	ery ec
	4