

:3 סדרה

:1 סדרה

$$(\lambda z. z)(\lambda y. y y)(\lambda x. x a) \Rightarrow (\lambda y. y y)(\lambda x. x a) \Rightarrow (\lambda x. x a)(\lambda x. x a) \Rightarrow$$

$$(\lambda x. x a) a \Rightarrow a a$$

$$((\lambda x. \lambda y. x y)(\lambda y. y) w) \Rightarrow (\lambda x. \lambda y. x y)(\lambda z. z) w \Rightarrow (\lambda z. z) w \Rightarrow w$$

$$(\lambda x. y)((\lambda y. y y y)(\lambda x. x x x)) \Rightarrow (\lambda x. y)(\lambda x. x x x)(\lambda x. x x x)(\lambda x. x x x)$$

מיושם  $(\lambda x. x x x)$  3 פעמים על ידי call by value של המכונה. פרויקט זה נועד להדגיש

$$\text{rec fact } 2 \Rightarrow \text{fact}(\text{rec fact } 2) \Rightarrow (\lambda f. \lambda n. \text{if } n=1 \text{ then } 1 \text{ else } n * f(n-1))(\text{rec fact } 2)$$

$$\Rightarrow \lambda n. \text{if } n=1 \text{ then } 1 \text{ else } n * \text{rec fact } n-1 \Rightarrow \text{if } 2=1 \text{ then } 1 \text{ else } 2 * \text{rec fact } 1$$

$$\Rightarrow 2 * \text{rec fact } 1 \Rightarrow 2 * \text{fact}(\text{rec fact } 1) \Rightarrow$$

$$2 * (\lambda f. \lambda n. \text{if } n=1 \text{ then } 1 \text{ else } n * f(n-1))(\text{rec fact } 1) \Rightarrow$$

$$2 * (\lambda n. \text{if } n=1 \text{ then } 1 \text{ else } n * \text{rec fact } n-1) 1 \Rightarrow$$

$$2 * \text{if } 1=1 \text{ then } 1 \text{ else } 1 * \text{rec fact } 1-1 \Rightarrow 2 * 1 = \underline{2}$$

:2 סדרה

$$\text{test (or true Els)} ab \Rightarrow$$

$$\Rightarrow (\lambda l. \lambda m. \lambda n. l m n)(\lambda b. \lambda f. b \text{ true c})(\lambda t. \lambda f. t)(\lambda t. \lambda f. f) a b \Rightarrow$$

def true = B

$$(\lambda l. \lambda m. \lambda n. l m n)(\lambda t. \lambda f. t)(\lambda t. \lambda f. t)(\lambda t. \lambda f. f) a b \Rightarrow$$

$$(\lambda l. \lambda m. \lambda n. l m n)(\lambda t. \lambda f. t) a b \Rightarrow (\lambda t. \lambda f. t) a b \Rightarrow \underline{a}$$



$not = \lambda b. b \text{ fls tru}$  ,  $or = \lambda b. \lambda c. b \text{ tru } c$  - e. r. s. (1)  
 $nor = \lambda x. \lambda y. (not (or x y)) \Rightarrow \lambda x. \lambda y. ((\lambda b. b \text{ fls tru})(\lambda b. \lambda c. b \text{ tru } c) x y) \Rightarrow$   
 $\lambda x. \lambda y. ((\lambda b. b \text{ fls tru})(x \text{ tru } y)) \Rightarrow \lambda x. \lambda y. ((x \text{ tru } y) \text{ fls tru})$

: Nor se tamen n'olac

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

$nor \text{ tru fls} \Rightarrow \lambda x. \lambda y. ((x \text{ tru } y) \text{ fls tru}) \text{ tru fls} \Rightarrow \lambda y. ((tru \text{ tru } y) \text{ fls tru}) \text{ fls}$  (2)  
 $\Rightarrow (tru \text{ tru fls}) \text{ fls tru} \Rightarrow ((\lambda t. \lambda f. t)(\lambda t. \lambda f. t)(\lambda t. \lambda f. f)) \text{ fls tru} \Rightarrow$   
 $((\lambda f. (\lambda t. \lambda f. t))(\lambda t. \lambda f. f)) \text{ fls tru} \Rightarrow (\lambda t. \lambda f. f) \text{ fls tru} \Rightarrow$   
 $(\lambda t. \lambda f. f)((\lambda t. \lambda f. f)(\lambda t. \lambda f. t)) \Rightarrow (\lambda f. (\lambda t. \lambda f. f))(\lambda t. \lambda f. t) \Rightarrow \lambda t. \lambda f. f = \text{fls}$

$nor \text{ tru tru} \Rightarrow \lambda x. \lambda y. ((x \text{ tru } y) \text{ fls tru}) \text{ tru tru} \Rightarrow (\lambda y. (tru \text{ tru } y) \text{ fls tru}) \text{ tru} \Rightarrow$   
 $(tru \text{ tru tru}) \text{ fls tru} \Rightarrow ((\lambda t. \lambda f. t)(\lambda t. \lambda f. t)(\lambda t. \lambda f. f))(\lambda t. \lambda f. f)(\lambda t. \lambda f. t) \Rightarrow$   
 $((\lambda f. (\lambda t. \lambda f. t))(\lambda t. \lambda f. t))(\lambda t. \lambda f. f)(\lambda t. \lambda f. t) \Rightarrow$   
 $(\lambda t. \lambda f. t)(\lambda t. \lambda f. f)(\lambda t. \lambda f. t) \Rightarrow \lambda f. ((\lambda t. \lambda f. f)(\lambda t. \lambda f. t)) \Rightarrow \lambda t. \lambda f. f \Rightarrow \text{fls}$

3. n'olac

$Succ \ C_1 = (\lambda n. \lambda s. \lambda z. s(n \ s \ z)) \ C_1 \Rightarrow \lambda s. \lambda z. s(C_1 \ s \ z)$  (1)  
 זכרונות כי לא ניתן להעביר רצף - רצף רצף רצף. פתוח של Call by Name, שכן ניתן להעביר  
 $Succ \ C_1 = (\lambda n. \lambda s. \lambda z. s(n \ s \ z)) \ C_1 \Rightarrow \lambda s. \lambda z. s(C_1 \ s \ z)$  (2)  
 זכרונות כי לא ניתן להעביר רצף רצף רצף. פתוח של Call by value, שכן ניתן להעביר  
 חסום ולתאר מן המעלה.

$isSeven = \lambda x. (x (\lambda b. b \text{ fls tru}) \text{ tru}) = \lambda x. (x \text{ not tru})$  : 7. 2. 1 (3)  
 $isSeven \ C_3 \Rightarrow (\lambda x. (x \text{ not tru})) \ C_3 \Rightarrow C_3 \text{ not tru} \Rightarrow (\lambda s. \lambda z. s(s(s(z)))) \text{ not tru}$  (3)  
 $\Rightarrow \lambda z. not(not(not \ z)) \text{ tru} \Rightarrow not(not(not \ tru)) \Rightarrow$   
 $not((\lambda b. b \text{ fls tru})((\lambda b. b \text{ fls tru}) \text{ tru})) \Rightarrow not((\lambda b. b \text{ fls tru})(\lambda t. \lambda f. t) \text{ fls tru})$   
 $\Rightarrow not((\lambda b. b \text{ fls tru}) \text{ fls}) \Rightarrow not(\text{fls fls tru}) \Rightarrow (\lambda b. b \text{ fls tru})(\text{fls fls tru})$   
 $\Rightarrow (\lambda b. b \text{ fls tru}) \text{ tru} \Rightarrow \text{tru fls tru} \Rightarrow (\lambda t. \lambda f. t) \text{ fls tru} \Rightarrow \text{fls}$



$isSeven\ c_4 = (\lambda x. (x\ not\ true))\ c_4 \Rightarrow c_4\ not\ true \Rightarrow (\lambda s. \lambda z. s(s(s(s\ z))))\ not\ true$   
 $\Rightarrow \lambda z. not(not(not(not\ z)))\ true \Rightarrow not(not(not(not\ true))) \Rightarrow$   
 $not(not(not(F\ true))) \Rightarrow not(not(true)) \Rightarrow not(F\ true) \Rightarrow true$

: 4 nake

: nake  $\forall$  nake  $T = Bool$  nu

	$T = true$		
	$F: Bool \rightarrow Bool \vdash true: Bool$		
	$T = true$	$T = false$	
$F: Bool \rightarrow Bool \in \{F: Bool \rightarrow Bool\}$	$T = var$	$F: Bool \rightarrow Bool \vdash true: Bool$	$F: Bool \rightarrow Bool \vdash false: Bool$
$F: Bool \rightarrow Bool \vdash F: Bool \rightarrow Bool$		$F: Bool \rightarrow Bool \vdash (if\ true\ then\ false\ else\ true): Bool$	
		$F: Bool \rightarrow Bool \vdash F(if\ true\ then\ false\ else\ true): Bool$	

: nake  $\forall$  nake  $T = Bool \rightarrow Bool$  nu

	$T = var$	$T = false$	$T = true$	
	$x: Bool \in \{F: Bool \rightarrow Bool\}$	$x: Bool$	$x: Bool$	
$F: Bool \rightarrow Bool \in \{F: Bool \rightarrow Bool\}, x: Bool$	$T = var$	$F: Bool \rightarrow Bool \vdash false: Bool$	$F: Bool \rightarrow Bool \vdash true: Bool$	$T = i$
$F: Bool \rightarrow Bool, x: Bool \vdash F: Bool \rightarrow Bool$		$F: Bool \rightarrow Bool, x: Bool \vdash if\ x\ then\ false\ else\ true: Bool$		$T = APP$
		$F: Bool \rightarrow Bool, x: Bool \vdash F(if\ x\ then\ false\ else\ true): Bool$		$T = ABS$
		$F: Bool \rightarrow Bool \vdash (\lambda x: Bool. F(if\ x\ then\ false\ else\ true)): Bool \rightarrow Bool$		

: nake  $\forall$  nake  $T = Bool \rightarrow Bool \rightarrow Bool$  nu

$T = var$	$x: Bool \in \{x: Bool, y: Bool \rightarrow Bool \rightarrow Bool\}$	$x: Bool \in \{x: Bool, y: Bool \rightarrow Bool \rightarrow Bool\}$	$T = var$
$x: Bool \rightarrow Bool \rightarrow Bool \in \{x: Bool, y: Bool \rightarrow Bool \rightarrow Bool\}$		$x: Bool, y: Bool \rightarrow Bool \rightarrow Bool \vdash x: Bool$	$T = APP$
$x: Bool, y: Bool \rightarrow Bool \rightarrow Bool \vdash y: Bool \rightarrow Bool \rightarrow Bool$		$x: Bool, y: Bool \rightarrow Bool \rightarrow Bool \vdash yx: Bool \rightarrow Bool$	$T = ABS$
$x: Bool \vdash \lambda y: Bool \rightarrow Bool \rightarrow Bool. yx: Bool \rightarrow Bool \rightarrow Bool \rightarrow Bool \rightarrow Bool$			$T = ABS$
		$\vdash \lambda x: Bool, \lambda y: Bool \rightarrow Bool \rightarrow Bool. yx: Bool \rightarrow Bool \rightarrow Bool \rightarrow Bool \rightarrow Bool$	