Lambda Calculus

Michelle Bergin

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1 Sel2013 Ex. 1,2,3

1. Evaluate the lambda-expression
   $(((\lambda f.\lambda x.f(f(f(x))))(\lambda g.\lambda y.g(g(y))))(\lambda z.z+1))(0)$
   Let $\lambda g.\lambda y.g(g(y)) =$ meow
   $= (\lambda x.meow(meow(meow(x)))(\lambda z.z+1))(0)$
   $= meow(meow(meow(\lambda z.z+1)))(0)$
   $= meow(meow(\lambda z.(\lambda z.z+1)+1))(0)$
   $= meow(\lambda z.(\lambda z.(\lambda z.z+1)+1)+1)(0)$
   $= meow(0+1+1+1)$
   $= meow(3)$
   Or something ...
2. What is $\omega(\omega)$
   ω?
3. (a) Write the following terms with as few parenthesis as possible, without changing the meaning or structure of the terms:
   i. $(\lambda x.(\lambda y.(\lambda z.((xz)(yz)))))$
   $\lambda xyz.xyz^2$? or
   $\lambda x.(\lambda y.\lambda z.xzyz)$
   ii. $(((ab)(cd))((ef)(gh)))$
   $abcdefgh$
   iii. $(\lambda x.((\lambda y.(yx))(\lambda v.v)z)u)(\lambda w.w)$
   Not sure

   (b) Restore all the dropped parentheses in the following terms, without changing the meaning or structure of the terms:
   i. $xxxx$
   $(x)(x)(x)(x)$
   ii. $\lambda x.x\lambda y.y$
   $(\lambda x.x)(\lambda y.y)$??
   iii. $\lambda x.(x\lambda y.yxx)x$
   $(\lambda x.(\lambda y.((y)(x)(x))x)x)$ I guess

2 Ker Comp Practice 1a,1b

1a. Which of the following are either terms or terms with parentheses unambiguously removed?

i unambiguously removed

ii unambiguously removed

iii terms

iv terms

v terms

1b. Write these terms with the minimum necessary parentheses:

i $\lambda x.(\lambda y.(\lambda z.zxy))$

ii $\lambda y.yyyy$

iii $\lambda xy.yz\lambda z.zz$

3 Ker Exercise 1.1, 1.2

1.1 i Rewrite $((xy)(\lambda y.(\lambda z.(z(xy)))))$ using the minimum number of parentheses.
$xy(\lambda y.\lambda z.zxy)$

ii Write the term $(\lambda xyz.xy(xz))\lambda xy.x$ in full syntax
$\lambda x.(\lambda y.(\lambda z.xy))(xz)\lambda x.(\lambda y.x)$

1.2