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Date: 10/16/2018

Assignment 5

1. Evaluate the following λ expression

a. ((λx.λy.(y x) λp.λq.p) λi.i)

(λy.(y λp.λq.p) λi.i)

λi.i λp.λq.p

λp.λq.p

b. (((λx.λy.λz.((x y) z) λf.λa.(f a)) λi.i) λj.j)

((λy.λz.((λf.λa.(f a) y) z) λi.i) λj.j)

((λf.λa.(f a) λi.i) λj.j)

(λa.(λi.i a) λj.j)

(λi.i λj.j)

λj.j

c. (λh.((λa.λf.(f a) h) h) λf.(f f))

(λh.(λf.(f h) h) λf.(f f))

(λh.(h h) λf.(f f))

(λf.(f f) λf.(f f))

(λf.(f f) λf.(f f))

(λf.(f f) λf.(f f))

...Infinite Loop

d. ((λp.λq.(p q) (λx.x λa.λb.a)) λk.k)

((λp.λq.(p q) (λa.λb.a)) λk.k)

(λq.((λa.λb.a) q) λk.k)

((λa.λb.a) λk.k)

(λb.λk.k)

e. (((λf.λg.λx.(f (g x)) λs.(s s)) λa.λb.b) λx.λy.x)

(((λg.λx.(λs.(s s) (g x))) λa.λb.b) λx.λy.x)

(λx.(λs.(s s) (λa.λb.b x)) λx.λy.x)

(λs.(s s) (λa.λb.b λx.λy.x))

(λs.(s s) (λb.b))

(λb.b λb.b)

λb.b

2. Define a function:

a. def make triplet = λf.λs.λt.λfunc.(((func f) s) t)

b. def triplet first = λfirst.λsecond.λthird.first

c. def triplet second = λfirst.λsecond.λthird.second

d. def triplet third = λfirst.λsecond.λthird.third

3. Use α conversion to ensure unique names in the expressions in each of the following λ expressions:

a. λx.λy.(λx.y λy.x)

λx.λy.(λa.y λb.x)

b. λx.(x (λy.(λx.x y) x))

λx.(x (λy.(λa.a y) x))

c. λa.(λb.a λb.(λa.a b))

λa.(λb.a λc.(λx.x c))

d. (λfree.bound λbound.(λfree.free bound))

(λfree.bound λa.(λb.b a))

e. λp.λq.(λr.(p (λq.(λp.(r q)))) (q p))

λp.λq.(λr.(p (λa.(λp.(r a)))) (q p))

4. Define a λ calculus representation for implication:

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def implies = λx.λy((x y) true)
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5. Define a λ calculus representation for equivalence:

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def equiv = λx.λy((x y) ((y false) true))
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6. Write a function that finds the product of the numbers between n and one:

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rec prod n =
    if isone n then f
    else prod (mult n (pred n))
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