Homework 3. Programming Language Design & Analysis (CSE 497)

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Due date: Sept. 15th in class.


   function f(x)
       return x+4
   end;
   function g(y)
       return 3-y
   end;
   f(g(1));

   can be written as the following lambda expression:

   \[
   \left( \lambda f. \lambda g. f \left( g \right) 1 \right) \left( \lambda x. x+4 \right) \left( \lambda y. 3-y \right)
   \]

   Reduce the expression to a normal form in two different ways, as described below. (Note the evaluation strategies below are different from the call-by-value strategy we discussed in class).

   - Reduce the expression by choosing, at each step, the reduction that eliminates a \( \lambda \) as far to the left as possible.
   - Reduce the expression by choosing, at each step, the reduction that eliminates a \( \lambda \) as far to the right as possible.

2. (2 points) For the lambda expression \( \left( \lambda x. \lambda y. x y \right) \left( \lambda x. x y \right) \).

   (a) Use the call-by-value reduction strategy to find its normal form. You may need to rename some bound variables.

   (b) Describe what goes wrong if you do not rename bound variables.
3. (2 points) In λ-calculus, define a term called even. It takes a Church Numeral and returns a Church Boolean; it returns true if and only if the input number is an even number. (Hint: you are allowed to use those terms already defined in the textbook.)