

## CS 510Types Homework 2 – due 10am, Thursday, Oct. 13, 2005

Homework must be submitted on paper in class. All programs mentioned can be downloaded via the course web page.

1. Consider the expression

$(\lambda h.(\lambda x.h(xx))(\lambda x.h(xx))((\lambda a\lambda b.a)(+ 1 5)))$

- (a) Draw the tree corresponding to this expression.
  - (b) Underline all the redexes, indicating whether they are  $\beta$ ,  $\eta$ , or  $\delta$  redexes.
  - (c) Identify the leftmost-outermost and leftmost-innermost redexes.
  - (d) Assuming that we use *only* the  $\beta$ -rule, and use normal order reduction, write down the normal form and weak head-normal form of the expression, showing the steps required to reach them.
2. Do Pierce 5.2.2.
  3. Do Pierce 5.2.4.
  4. Do Pierce 5.2.8.
  5. Do Pierce 5.3.3.
  6. Do Pierce 5.3.8.
  7. Do Pierce 6.1.1.
  8. Do Pierce 6.2.2.
  9. Do Pierce 7.3.1. Once again, just change the implementation of the `eval` function in `core.ml`. If no big-step rule applies, raise the `NoRuleApplies` exception; unlike in the small-step case, this should *not* be caught, but should instead propagate to the top level. (Note that variables are *not* values.) Submit just your changed `core.ml` file.