Problem Set 2 Due Friday Feb. 24

***CS6116 are assigned only the starred problems.**

Problem 1

Show that if $eval_{cbv}(t)$ converges to a value, then $eval_{cbv}(t, [\,])$ converges to a value. Explain why this is important in comparing the two evaluation methods, $eval_{cbv}$ and $eval_{cbv}$ with closures.

Problem 2

Write a call by name evaluator with closures that also counts the number of steps (as in Lect 11 example).

* Problem 3

How would you express Euclid's Theorem that any two numbers a, b have a greatest common divisor using Primitive Recursive Arithmetic, a la Goodstein, as your logic.

For any natural number a and positive number b there are natural numbers q and r such that $a = b \cdot q + r \quad \& \quad 0 \leq r < b$.

Problem 4

Write Euclid's algorithm in IMP, see CS6110 2010 Lecture 6.

Problem 5

Show that in call by value evaluation according to $eval_{cbv}$, there is no need to rename bound variables at any step of the procedure.

* Problem 6

Write the $3x + 1$ function below using *continuations* (see Lect14 CS6110 2010 also posted with Lect11, Feb 15, 2012).

$$
\begin{aligned}
f(x) = \ & \textbf{if } (x = 0 \vee x = 1) \textbf{ then } 1 \\
& \textbf{else } \ \textbf{if } even(x) \textbf{ then } f(x/2) \\
& \qquad\ \ \textbf{else } f(3x+1)
\end{aligned}
$$

Optional Problems on Next Page

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Problem 7 (Optional)
Suggest two proof strategies for the equivalence of evaluators theorem in Lecture 10. One of them can be the subcomputations method sketched in class. State the theorem carefully as in Lecture 10.

Problem 8 (Optional)
Use a Y combinator to define the addition function in the applied λ-calculus with *case*, 0. As in Problem Set 1 problem 5 show the computation of $add(S(0), S(S(0)))$.

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