EECS 4111/5111 —Fall 2021

Posted: Sept. 19, 2013
Due: TBA by a NEWS item on the course web page.
You have a window of three weeks at least.

Problem Set No. 1

NB. *All problems are equally weighted out of 5.* The problem set list for *grad students* enrolled in EECS5111 is the entire list here. Undergrads *should omit the problems marked "***Grad only***".*

This is not a course on *formal* recursion theory. Your proofs should be *informal* (but NOT sloppy), *completely argued*, correct, and informative (and if possible *short*). Please do not trade length for correctness or readability.

All problems are from the "Theory of Computation Text", or are improvisations I completely articulate here.

(1) Do Exercise 2.1.2.6, 2.1.2.10.

(2) Dress up the primitive recursive definition of $\lambda xy.xy$ to obtain the "rigid" form of it.

From Section 2.12.

(3) (**Grad only**). Do problems 5, 20, 30 (note re #30: In the Notes, we use $\langle \ldots \rangle$ rather than $[\ldots]$; they denote the same concept).

(4) Do problems 6, 7, 35.

(5) Prove that the function $\lambda x.\|x\|$, where $\|x\|$ denotes the number of binary digits of $x \in \mathbb{N}$, is in $\mathcal{PR}$.

(6) Write a "nice and clean" loop program which computes $\lambda x.\lfloor x/5 \rfloor$. The program must only allow instruction-types $X \leftarrow 0$, $X \leftarrow X+1$, $X \leftarrow Y$ and **Loop** $X \ldots$ **end**. It must *not* nest the Loop-end instruction! It is required that you give a convincing general argument (*NOT* a "trace") as to why your program works as specified.

(7) Add to our loop program syntax the stipulation that all instructions are *labelled* by numbers that denote the instruction position.

Can such loop programs simulate (i.e., can you write a "macro" for)

(a) A forward **go to**? If yes, exactly how? If no, why not?

(b) A backward **go to**? If yes, exactly how? If no, why not?

This is not a yes/no question. Where you say “yes” you must give the correct (with justification) **macro**. Where you say “no” you must give a short proof that it cannot be done.

(8) (**Grad only**). Do problem 29.