Exam: Models of Computation TDA183 – DIT310

Date: Dec 12, 14.00 - 18.00

Permitted aids: English-Swedish or English-other language dictionary.

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All solutions must be explained! It is not enough to just give a program without an explanation of why it works. The examination of the course consists of three parts: homework assignments count up to 40 points, weekly exercises up to 20 points and this written exam up to 140 points (20 points for each part of a problem). You have to have 100 points in total in order to pass the course.

Solutions to the exam will be available from the homepage of the course.

+ z : PRF0 s : PRF1 pn(i) : PRFn+1 if i <= n comp(g, fs) : PRFn if g : PRFm, fs : (PRFn)m rec(g, h) : PRFn+1 if g : PRFn, h : PRFn+2

1. Give an example of an open term in lambda-calculus which has a normal form which is closed.
2. What does it mean that a function `f : N -> N` is Turing-computable?
3. State Church's thesis! Explain why it is not called Church's theorem and explain why we believe it is true.
4. One argument why not all functions in `N -> N` are computable is that there are more functions in `N -> N` then algorithms. In order to understand this argument you have to
   (a) explain what it means that one infinite set has more elements than another infinite set
   (b) explain why `N -> N` has more elements than the set of algorithms.
5. Show how to extend the language **PRF** of primitive recursive functions to a language **RF** (recursive functions) so that it can express all computable functions! It is enough if you give the syntax and semantics of the extension, there is no need to describe the entire **PRF**. In giving the syntax, you must be precise about the arity of the functions involved.
6. Define what it means for a program in **X** to be a self-evaluator. In order to do this you have to explain how to represent **X**-programs in **X**. There is no need to do this in full detail, just outline the construction.

Good Luck!

Bengt