Take-Home Project 2
Semantics, WS 2013/14

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www.ps.uni-saarland.de/courses/sem-ws13/

To be handed in: 2014-01-16, until 12 p.m.

This is a take-home project that will contribute to your grade. The maximal score for the project is 30 points. You may use the lecture notes, textbooks, and the sources specified on the Resources page of the course. You may search the web, but you must not copy Coq code. You may ask the course staff for clarifications, but otherwise you may not receive help from other people.

For the project you will prove the following results for the untyped lambda calculus:

1. The composition law: $\sigma\,!\,\tau\,!\,s = \sigma \cdot \tau\,!\,s$.
2. Substitutivity of β-reduction: $s \succ t \to \sigma\,!\,s \succ \sigma\,!\,t$.
3. Substitution does not affect closed terms: $\mathit{closed}\ s \to \sigma\,!\,s = s$.

You are given a Coq file containing the necessary definitions and the statements of the results. Your job is to fill in the proofs we deleted from the file. We also deleted some auxiliary lemmas we use in the sample development. So you will have to formulate and prove some lemmas not yet specified in the file.

Take the mathematical discussion of the results in the lectures and the lecture notes as your starting point. Make sure that you fully understand the mathematical development. Also make sure you understand how the lack of subtyping and functional extensionality is compensated for in the Coq development.

Try to come up with transparent scripts that reflect the mathematical proofs. For full credit your proofs should be reasonably elegant.

The Coq file specifies a number of extra problems that will not be graded and will not contribute to your final score for the project.

Send your solution file to schaefer@ps.uni-saarland.de. To receive credit, we must have received your file by Thursday, January 16, 2014, 12:00 noon. We will only look at files that compile with Coq 8.4.