

Formal Semantics of Programming Languages Exercise 2 (May 13)

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The exercise is to be submitted by the deadline stated above as a report with a decent cover page (title of the course, your name, Matrikelnummer, email address) in one of the following forms:

1. either as a single PDF file uploaded in Moodle (no emails, please), or
2. as a stapled paper report handed out to me (in class or in my mailbox).

1 Expressions with Side effects

Take the following language of commands C , expressions E , numerals N , and identifiers I :

$$\begin{aligned} C &::= I := E \mid C_1; C_2 \mid \mathbf{if} (E_1 = E_2) C \\ E &::= I \mid N \mid E_1 + E_2 \mid \mathbf{exec} C \mathbf{result} E \end{aligned}$$

The **exec** expression executes C and then returns the result of the evaluation of E . Correspondingly, the evaluation of an expression may alter the store.

1. Define a denotational semantics for this language.
2. Define a big-step operational semantics for this language with transitions $\langle E, s \rangle \rightarrow \langle n, s' \rangle$ (expression E evaluated in store s yields number n and store s').
3. Formulate the statement “the operational semantics of E is sound with respect to the denotational semantics” and prove this statement.
4. Define a small-step operational semantics for this language.
5. Formulate the statement “the small-step operational semantics of E corresponds to its big-step semantics”.