

Formal Semantics of Programming Languages

Exercise 1 (November 3)

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The exercise is to be submitted by **November 3** (hard deadline)

1. as a single PDF file sent to me per email, or
2. as a paper report (cover page with full name and Matrikelnummer, pages stapled) handed out to me in class.

1 A Shop Database

Define the denotational semantics (abstract syntax, semantic algebras, valuation functions) of a language for maintaining the database of a shop. The language shall allow to enter a sequence of commands that perform the following actions:

- Enter a new article A with price P and quantity N into the store.
- Sell N copies of article A at its current price.
- Add N copies of article A to the store.
- Get the current price of article A .
- Change the price of article A to a new value P .
- Determine the quantity of sales of article A and its average sale price P .

Hint: the language must maintain a “database” that maps each article A to its current price, available quantity, number of copies sold, and the total price achieved in these sales. Each command has to read and potentially update the database and to deliver an “answer” (which may be e.g. a boolean value indicating the success of the action or the price of an article); the signature of the valuation function for commands is thus of form

$$\mathbf{C} : \text{Command} \rightarrow \text{Database} \rightarrow (\text{Database} \times \text{Answer})$$

The result of the overall “command session” is correspondingly (the final state of) the database and a sequence of answers.