

note @118

153 views

Semantics practice problems

Here are a couple example problems for defining and implementing a semantics with a functional domain. The first one is easier, the second one is trickier.

The solutions are uploaded here: [SemanticsPractice.hs](#)

Please post questions in separate threads since it makes it easier for other students to see them.

Example 1:

Consider the following language for implementing a simple counter. Statements either increment the counter by a given integer, or they reset the counter to zero. A program runs a sequence of statements on an initial counter of 0 and returns the final value of the counter.

```
i ::= (any integer)
s ::= inc i
    | reset
p ::= s ; p
    | ε
```

1. What is a good semantic domain for statements?
2. Implement the language in Haskell by (a) encoding the abstract syntax as a Haskell data type, (b) implementing valuation functions for both statements and programs.

Example 2:

Consider the following command language for controlling a robot that moves in a one-dimensional space (i.e. back and forth along a line).

```
data Cmd = Gas | Brake | Turn
type Prog = [Cmd]
```

The state of the robot is represented by three components: its current position on the line, its current direction, and its speed. Moving forward corresponds to increasing the position, while moving backward decreases the position.

```
type Pos = Int
type Speed = Int
data Dir = Forward | Backward
```

The commands work as follows:

- Gas: Move in the current direction an amount equal to the current speed, then increase the speed by one. For example, if the robot is at position 5 while moving forward at a speed of 2, after executing a Gas command the robot would be at position 7 moving at a speed of 3.
- Brake: Move in the current direction an amount equal to the current speed, then decrease the speed by one down to a minimum speed of 0. If the robot is already at speed 0, then a Brake command has no effect.
- Turn: If the current speed of the robot is 0, then change the direction of the robot. If the speed is not 0, the robot crashes. If the robot crashes, it no longer has a speed or direction, but it does still have a position (the position it was at when it crashed).

1. What is a good semantic domain for commands?
2. Implement semantic functions for Cmd and Prog.

[midterm](#)

Updated 3 days ago by Eric Walkingshaw

followup discussions *for lingering questions and comments*