COMS22201: Language Engineering

Lab Exercises - Week 22 - Questions

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This worksheet will give you practice in using, extending and reasoning about the structural operational semantics.

1. Use the structural operational semantics to evaluate the following program (for computing factorials) from a state s which maps variable x to integer 3 (cf. ex 2.15 on p34-5 of the textbook):

   ```
   y:=1; while (x=1) do (y:=y*x; x:=x-1)
   ```

2. Use the structural operational semantics to evaluate the following program (for computing moduli) from a state t which maps x to 17 and y to 5 (cf. ex 2.16 on p35-6 of the textbook):

   ```
   z:=0; while y<x do (z:=z+1; x:=x-y)
   ```

3. Write a structural operational semantics for a loop construct of the form `repeat S until b` in a way that does not rely on the existence of any other loop construct (cf. ex 2.17 on p36).

4. Write a structural operational semantics for a loop construct of the form `for x := a1 to a2 do S` in a way that does not rely on the existence of any other loop construct (cf. ex 2.18 on p36).

5. Suppose there exists a derivation sequence $\langle S_1; S_2, s\rangle \Rightarrow \cdots \Rightarrow \langle S_2, s'\rangle$. Show it is not necessarily the case that there exists a derivation sequence $\langle S_1, s\rangle \Rightarrow \cdots \Rightarrow s'$ (cf. ex 2.20 on p38).

6. Conversely, suppose there exists a derivation sequence $\langle S_1, s\rangle \Rightarrow \cdots \Rightarrow s'$. Show it is necessarily the case that there exists a derivation sequence $\langle S_1; S_2, s\rangle \Rightarrow \cdots \Rightarrow \langle S_2, s'\rangle$ (cf. ex 2.21 on p38).

7. Write a structural operational semantic evaluator in Haskell.