

Program Analysis Recitation 2

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Operational semantics provides a way of understanding what a program means by mimicking, at a high level, the operation of a computer executing the program. Operational semantics falls under two broad classes: big-step operational semantics, which specifies the entire operation of a given expression or statement; and small-step operational semantics, which specifies the operation of the program one step at a time. Both are powerful tools for verifying the correctness and other desired properties of programs.

Exercises

- Use the big-step operational semantics rules for the WHILE language to write a well-formed derivation with the conclusion: $\langle E, i := 0; \text{while } i < 1 \text{ do } i := i + 1 \Downarrow E[i \mapsto 1] \rangle$. Make sure to indicate which rule you used to prove each premise or conclusion.

$$\begin{array}{c}
 \text{VAR } \frac{}{\langle E[i \mapsto 1], i \rangle \Downarrow 1} \quad \text{INT } \frac{}{\langle E[i \mapsto 1], 1 \rangle \Downarrow 1} \\
 \text{BOOLOP } \frac{}{\langle E[i \mapsto 1], i < 1 \rangle \Downarrow \text{false}} \\
 \frac{}{\langle E[i \mapsto 1], \text{while } i < 1 \text{ do } i := i + 1 \rangle \Downarrow E[i \mapsto 1]} \text{ WHILE-FALSE} \\
 \vdots \\
 \text{INT } \frac{}{\langle E, 0 \rangle \Downarrow 0} \quad \text{VAR } \frac{}{\langle E[i \mapsto 0], i \rangle \Downarrow 0} \quad \text{INT } \frac{}{\langle E[i \mapsto 0], 1 \rangle \Downarrow 1} \\
 \text{BOOLOP } \frac{}{\langle E[i \mapsto 0], i < 1 \rangle \Downarrow \text{true}} \quad \text{ASSIGN } \frac{}{\langle E[i \mapsto 0], i := i + 1 \rangle \Downarrow E[i \mapsto 1]} \\
 \text{ASSIGN } \frac{}{\langle E, i := 0 \rangle \Downarrow E[i \mapsto 0]} \quad \text{WHILE-TRUE } \frac{}{\langle E[i \mapsto 0], \text{while } i < 1 \text{ do } i := i + 1 \rangle \Downarrow E[i \mapsto 1]} \\
 \text{SEQ } \frac{}{\langle E, i := 0; \text{while } i < 1 \text{ do } i := i + 1 \rangle \Downarrow E[i \mapsto 1]}
 \end{array}$$

- Please see the other PDF for exercise 2.