



CS101.3 Programing Language Semantics

Lecture 2

January 16, 2004



Operational Semantics — Reminder

Large step semantics:

- $\langle \sigma, n \rangle \rightarrow n$
- $\langle \sigma, X \rangle \rightarrow \sigma(X)$
- $\frac{\langle \sigma, a_1 \rangle \rightarrow n_1 \quad \langle \sigma, a_2 \rangle \rightarrow n_2}{\langle \sigma, a_1 \text{ op } a_2 \rangle \rightarrow n}$, where $n = n_1 \text{ op } n_2$.

Small step semantics:

- $\langle \sigma, X \rangle \rightarrow_1 \langle \sigma, \sigma(X) \rangle$
- $\frac{\langle \sigma, a_1 \rangle \rightarrow_1 \langle \sigma, a'_1 \rangle}{\langle \sigma, a_1 \text{ op } a_2 \rangle \rightarrow_1 \langle \sigma, a'_1 \text{ op } a_2 \rangle}$
- $\frac{\langle \sigma, a_2 \rangle \rightarrow_1 \langle \sigma, a'_2 \rangle}{\langle \sigma, a_1 \text{ op } a_2 \rangle \rightarrow_1 \langle \sigma, a_1 \text{ op } a'_2 \rangle}$



Operational Semantics — Exercise

Prove that for any $\sigma, \sigma' \in \Sigma$ and any $c \in \mathbf{Cexp}$,
 $\langle \sigma, \mathbf{while\ true\ do\ } c \rangle \rightarrow \sigma'$ can not be true.



Equivalence of Two Semantics

We will define “ $\langle \sigma, e \rangle \rightarrow_1^* \langle \sigma', e' \rangle$ ” (where e is in **Aexp**, **Bexp**, or **Cexp**) as “for some number n (possibly 0)

$$\langle \sigma_0, e_0 \rangle \rightarrow_1^* \langle \sigma_1, e_1 \rangle \rightarrow_1^* \dots \rightarrow_1^* \langle \sigma_n, e_n \rangle$$

and σ_0 is σ , e_0 is e , σ_n is σ' , and e_n is e' .”

Theorem.

$\langle \sigma, a \rangle \rightarrow n$ if and only if for some σ' , $\langle \sigma, a \rangle \rightarrow_1^* \langle \sigma', n \rangle$

$\langle \sigma, b \rangle \rightarrow t$ if and only if for some σ' , $\langle \sigma, b \rangle \rightarrow_1^* \langle \sigma', t \rangle$

$\langle \sigma, c \rangle \rightarrow \sigma'$ if and only if $\langle \sigma, c \rangle \rightarrow_1^* \langle \sigma', \mathbf{skip} \rangle$





Announcements

- **Office Hours:** Jorgensen 60, Thursdays 2PM and by appointment.
- **Homework 1:** will be posted today, **due** next week (Friday, January 23) in class.

