Program Analysis

Operational Semantics (Part 5)

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Plan for Today

- **Motivation & preliminaries**
- **Abstract syntax of SIMP**
- **An abstract machine for SIMP**
- **Structural operation semantics for SIMP**
  - Small-step semantics
  - Big-step semantics 

Big-step Semantics

- small-step semantics : transition relation
  = individual step of computation

- now : transition relation
  = full evaluation

- configurations remain the same

- evaluation relation:

$$\langle P, s \rangle \Downarrow \langle P', s' \rangle$$

"evaluates to"

$\langle P', s' \rangle$: last config. of $\langle P, s \rangle$'s evaluation seqn. (if P terminates)

(Some) axioms & rules

$$\frac{}{\langle !\ell, s\rangle \Downarrow \langle n, s\rangle \quad \text{if } s(\ell) = n} \text{ (var)}$$

Almost as before.

$$\frac{\langle E, s\rangle \Downarrow \langle n, s'\rangle}{\langle \ell := E, s\rangle \Downarrow \langle \text{skip}, s'[\ell \mapsto n]\rangle} \text{ (:=)}$$

Much simpler: 1 rule instead of 2

$$\frac{\langle C_1, s\rangle \Downarrow \langle \text{skip}, s'\rangle \qquad \langle C_2, s'\rangle \Downarrow \langle \text{skip}, s''\rangle}{\langle C_1 ; C_2, s\rangle \Downarrow \langle \text{skip}, s''\rangle} \text{ (seq)}$$

Example $P = \underbrace{(z := !x ; x := !y)}_{P'} ; \underbrace{y := !z}_{P''}$

$s = \{ z \mapsto 0, x \mapsto 1, y \mapsto 2 \}$

$\langle P, s \rangle \Downarrow \langle skip, s' \rangle$ where $s' = \{ z \mapsto 1, x \mapsto 2, y \mapsto 1 \}$