

Structural Operational Semantics

The following rules applies to my whole semantics:

1. " σ ", " σ' ", " σ'' " are states.
2. " $e1$ ", " $e2$ ", ..., " en " are expressions.
3. " $c1$ ", " $c2$ " are commands.
4. " $n1$ ", " $n2$ " are integers.
5. " t ", " $t1$ ", " $t2$ ", ..., " tn " are terminals.
6. " x " is a variable.
7. " τ " means anything.

Operations of numerical arithmetic:

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 + e2, \sigma \rangle \Downarrow n1 \text{ plus } n2} \quad (1)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 * e2, \sigma \rangle \Downarrow n1 \text{ times } n2} \quad (2)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 - e2, \sigma \rangle \Downarrow n1 \text{ minus } n2} \quad (3)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 / e2, \sigma \rangle \Downarrow n1 \text{ divide } n2} \quad (4)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 \% e2, \sigma \rangle \Downarrow n1 \text{ modulo } n2} \quad (5)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 ^ e2, \sigma \rangle \Downarrow n1 \text{ power } n2} \quad (6)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1}{\langle -e1, \sigma \rangle \Downarrow \text{minus } n1} \quad (7)$$

Operations of boolean arithmetic:

and

$$\frac{\langle e1, \sigma \rangle \Downarrow false, \langle e2, \sigma \rangle \Downarrow \tau}{\langle e1 \ \&\& \ e2, \sigma \rangle \Downarrow false} \quad (8)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow \tau, \langle e2, \sigma \rangle \Downarrow false}{\langle e1 \ \&\& \ e2, \sigma \rangle \Downarrow false} \quad (9)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow true, \langle e2, \sigma \rangle \Downarrow true}{\langle e1 \ \&\& \ e2, \sigma \rangle \Downarrow true} \quad (10)$$

or

$$\frac{\langle e1, \sigma \rangle \Downarrow true, \langle e2, \sigma \rangle \Downarrow \tau}{\langle e1 \ || \ e2, \sigma \rangle \Downarrow true} \quad (11)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow \tau, \langle e2, \sigma \rangle \Downarrow true}{\langle e1 \ || \ e2, \sigma \rangle \Downarrow true} \quad (12)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow false, \langle e2, \sigma \rangle \Downarrow false}{\langle e1 \ || \ e2, \sigma \rangle \Downarrow false} \quad (13)$$

negation

$$\frac{\langle e1, \sigma \rangle \Downarrow true}{\langle !e1, \sigma \rangle \Downarrow false} \quad (14)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow false}{\langle !e1, \sigma \rangle \Downarrow true} \quad (15)$$

Other operations:

equals

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n1}{\langle e1 == e2, \sigma \rangle \Downarrow true} \quad (16)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 == e2, \sigma \rangle \Downarrow false} \quad (17)$$

not equals

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n1}{\langle e1 != e2, \sigma \rangle \Downarrow false} \quad (18)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 != e2, \sigma \rangle \Downarrow true} \quad (19)$$

less than

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2, n1 < n2}{\langle e1 < e2, \sigma \rangle \Downarrow true} \quad (20)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow n1, \langle e2, \sigma \rangle \Downarrow n2, n1 \geq n2}{\langle e1 < e2, \sigma \rangle \Downarrow false} \quad (21)$$

parentheses

$$\frac{\langle e1, \sigma \rangle \Downarrow t}{\langle (e1), \sigma \rangle \Downarrow t} \quad (22)$$

function call

$$\frac{\langle e1, \sigma \rangle \Downarrow t1, \langle e2, \sigma \rangle \Downarrow t2, \dots, \langle en, \sigma \rangle \Downarrow tn, \langle f(t1, t2, \dots, tn), \sigma \rangle \Downarrow \langle t, \sigma' \rangle}{\langle f(e1, e2, \dots, en), \sigma \rangle \Downarrow \langle t, \sigma' \rangle} \quad (23)$$

Commands

if

$$\frac{\langle e1, \sigma \rangle \Downarrow \text{true}, \langle c1, \sigma \rangle \Downarrow \sigma'}{\langle \text{if } e1 \text{ then } c1 \text{ else } c2, \sigma \rangle \Downarrow \sigma'} \quad (24)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow \text{false}, \langle c2, \sigma \rangle \Downarrow \sigma''}{\langle \text{if } e1 \text{ then } c1 \text{ else } c2, \sigma \rangle \Downarrow \sigma''} \quad (25)$$

while

$$\frac{\langle e1, \sigma \rangle \Downarrow \text{false}}{\langle \text{while } e1 \text{ do } c1, \sigma \rangle \Downarrow \sigma} \quad (26)$$

$$\frac{\langle e1, \sigma \rangle \Downarrow \text{false}, \langle c1, \sigma \rangle \Downarrow \sigma', \langle \text{while } e1 \text{ do } c1, \sigma' \rangle \Downarrow \sigma''}{\langle \text{while } e1 \text{ do } c1, \sigma \rangle \Downarrow \sigma'} \quad (27)$$

declaration, assignment

$$\frac{}{\langle x := n, \sigma \rangle \Downarrow \sigma[x := n]} \quad (28)$$