

# Structural Operational Semantics

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November 17, 2020

# 1 SOS

## 1.1 i32

$$\langle e, \sigma \rangle \Downarrow n \quad (1)$$

## 1.2 bool

$$\langle e, \sigma \rangle \Downarrow b \quad (2)$$

## 1.3 Unop

### 1.3.1 Not

$$\frac{\langle b, \sigma \rangle \Downarrow false}{\langle !b, \sigma \rangle \Downarrow true} \quad (3)$$

$$\frac{\langle b, \sigma \rangle \Downarrow true}{\langle !b, \sigma \rangle \Downarrow false} \quad (4)$$

### 1.3.2 Sub

$$\frac{\langle e, \sigma \rangle \Downarrow n}{\langle -e, \sigma \rangle \Downarrow -n} \quad (5)$$

## 1.4 Binop

### 1.4.1 Add

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

**1.4.2 Sub**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 - e2, \sigma \rangle \Downarrow n1 - n2} \quad (7)$$

**1.4.3 Div**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 / e2, \sigma \rangle \Downarrow n1 / n2} \quad (8)$$

**1.4.4 Multiplication**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 * e2, \sigma \rangle \Downarrow n1 * n2} \quad (9)$$

**1.4.5 Mod**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 \% e2, \sigma \rangle \Downarrow n1 \% n2} \quad (10)$$

**1.4.6 And**

$$\frac{\langle b1, \sigma \rangle \Downarrow false \quad \langle b2, \sigma \rangle \Downarrow false}{\langle e1 \& \& e2, \sigma \rangle \Downarrow false} \quad (11)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow true \quad \langle b2, \sigma \rangle \Downarrow false}{\langle e1 \& \& e2, \sigma \rangle \Downarrow false} \quad (12)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow false \quad \langle b2, \sigma \rangle \Downarrow true}{\langle e1 \& \& e2, \sigma \rangle \Downarrow false} \quad (13)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow true \quad \langle b2, \sigma \rangle \Downarrow true}{\langle e1 \& \& e2, \sigma \rangle \Downarrow true} \quad (14)$$

**1.4.7 Or**

$$\frac{\langle b1, \sigma \rangle \Downarrow false \quad \langle b2, \sigma \rangle \Downarrow false}{\langle e1 || e2, \sigma \rangle \Downarrow false} \quad (15)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow true \quad \langle b2, \sigma \rangle \Downarrow false}{\langle e1 || e2, \sigma \rangle \Downarrow true} \quad (16)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow false \quad \langle b2, \sigma \rangle \Downarrow true}{\langle e1 || e2, \sigma \rangle \Downarrow true} \quad (17)$$

$$\frac{\langle b1, \sigma \rangle \Downarrow true \quad \langle b2, \sigma \rangle \Downarrow true}{\langle e1 || e2, \sigma \rangle \Downarrow true} \quad (18)$$

**1.4.8 Not equal**

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

$$\frac{\langle e1, \sigma \rangle \Downarrow n \quad \langle e2, \sigma \rangle \Downarrow n}{\langle e1! = e2, \sigma \rangle \Downarrow false} \quad (20)$$

**1.4.9 Equal**

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

$$\frac{\langle e1, \sigma \rangle \Downarrow n \quad \langle e2, \sigma \rangle \Downarrow n}{\langle e1 == e2, \sigma \rangle \Downarrow true} \quad (22)$$

**1.4.10 Less or equal then**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 <= e2, \sigma \rangle \Downarrow n1 <= n2} \quad (23)$$

**1.4.11 Larger or equal then**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 \geq e2, \sigma \rangle \Downarrow n1 \geq n2} \quad (24)$$

**1.4.12 Less then**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 < e2, \sigma \rangle \Downarrow n1 < n2} \quad (25)$$

**1.4.13 Larger then**

$$\frac{\langle e1, \sigma \rangle \Downarrow n1 \quad \langle e2, \sigma \rangle \Downarrow n2}{\langle e1 > e2, \sigma \rangle \Downarrow n1 > n2} \quad (26)$$

**1.5 Assignment**

$$\overline{\langle x := n, \sigma \rangle \Downarrow \sigma[x := n]} \quad (27)$$

**1.6 Variable**

$$\sigma[x := n] = n \quad (28)$$

**1.7 If**

$$\frac{\langle b, \sigma \rangle \Downarrow true \quad \langle c1, \sigma \rangle \Downarrow \sigma'}{\langle \text{if } b \text{ then } c1 \text{ else } c2, \sigma \rangle \Downarrow \sigma'} \quad (29)$$

$$\frac{\langle b, \sigma \rangle \Downarrow false \quad \langle c2, \sigma \rangle \Downarrow \sigma''}{\langle \text{if } b \text{ then } c1 \text{ else } c2, \sigma \rangle \Downarrow \sigma''} \quad (30)$$

## 1.8 While

$$\frac{\langle b, \sigma \rangle \Downarrow false}{\langle \mathbf{while} \ b \ \mathbf{do} \ c, \sigma \rangle \Downarrow \sigma} \quad (31)$$

$$\frac{\langle b, \sigma \rangle \Downarrow true \ \langle c, \sigma \rangle \Downarrow \sigma' \ \langle \mathbf{while} \ b \ \mathbf{do} \ c, \sigma' \rangle \Downarrow \sigma''}{\langle \mathbf{while} \ b \ \mathbf{do} \ c, \sigma \rangle \Downarrow \sigma''} \quad (32)$$

## 1.9 Function call

$$\frac{\langle c, \sigma \rangle \Downarrow \sigma'}{\langle \mathbf{call} \ c, \sigma \rangle \Downarrow \sigma'} \quad (33)$$

## 1.10 Return

$$\frac{\langle c, \sigma \rangle \Downarrow \sigma'}{\langle \mathbf{return} \ c, \sigma \rangle \Downarrow \sigma'} \quad (34)$$