

Two Pass Typing Rules

Rules

We use the following notations:

- Γ compute the size of an atom.
- Φ compute the size of a lvalue.

Base cases

$$\frac{s = \Gamma(e) \quad e \in \mathcal{A}}{\vdash e : n[s]}$$

Operators

- $\oplus \in \{+, -, *, /, \%, \&, |, \wedge, \sim, \sim\sim\}$:

$$\frac{\vdash a : n[s_a] \quad \vdash b : n[s_b] \quad s = \max\{s_a, s_b\}}{\vdash a \oplus b : n[s]}$$

- $\oplus \in \{+, -, ++, --, \sim\}$:

$$\frac{\vdash e : n[s]}{\vdash \oplus e : n[s]}$$

- $\oplus \in \{\$signed, \$unsigned\}$:

$$\frac{\vdash e : s[s]}{\vdash \oplus(e) : n[s]}$$

- $\oplus \in \{==, !=, ==?, !=?, ==, !=, >, >=, <, <=\}$:

$$\frac{\vdash a : s[s_a] \quad \vdash b : s[s_b] \quad s = \max\{s_a, s_b\}}{\vdash a \oplus b : n[1]}$$

- $\oplus \in \{\&\&, ||, -, <->\}$:

$$\frac{\vdash a : s_a[s_a] \quad \vdash b : s_b[s_b]}{\vdash a \oplus b : n[1]}$$

- $\oplus \in \{\&, \sim\&, |, \sim|, \wedge, \sim\wedge, \sim\sim, !\}$:

$$\frac{\vdash e : s[s]}{\vdash \oplus e : n[1]}$$

- $\oplus \in \{>>, <<, **, >>>, <<<\}$:

$$\frac{\vdash a : n[s] \quad \vdash b : s_b[s_b]}{\vdash a \oplus b : n[s]}$$

- $\oplus \in \{=, +=, -=, *=, /=, \%=, \&=, |=, \wedge=\}$:

$$\frac{s = \Phi(l) \quad \vdash e : n_e[s_e] \quad n_e = \max\{s_a, s\}}{\vdash l \oplus e : n[s]}$$

- $\oplus \in \{<<=<, >>=<, <<<=<, >>>=<\}$:

$$\frac{s = \Phi(l) \quad \vdash e : s_e[s_e]}{\vdash l \oplus e : n[s]}$$

- If expression:

$$\frac{\vdash e : s_e[s_e] \quad \vdash a : n[s_a] \quad \vdash b : n[s_b] \quad s = \max\{s_a, s_b\}}{\vdash e?a:b : n[s]}$$

- Concatenation:

$$\frac{\vdash e_1 : s_1[s_1] \quad \dots \quad \vdash e_k : s_k[s_k] \quad s = \sum_{i=1}^k s_i}{\vdash \{e_1, \dots, e_k\} : n[s]}$$

- Replication:

$$\frac{i \in \mathbb{N} \quad \vdash e : s_e[s_e] \quad s = i \times s_e}{\vdash \{i \ e\} : n[s]}$$