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

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

Operators

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- If expression:

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

- Concatenation:

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

- Replication:

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