

Linguaggi di Programmazione

Prontuario

Algoritmo di unificazione

delete

$\mathcal{G} \cup \{t \stackrel{?}{=} t\}$
becomes
 $\mathcal{G}$

eliminate

$\mathcal{G} \cup \{x \stackrel{?}{=} t\}$
becomes if $x \in vars(\mathcal{G}) \setminus vars(t)$
 $\mathcal{G}[x = t] \cup \{x \stackrel{?}{=} t\}$

swap

$\mathcal{G} \cup \{f(t_1, \dots, t_m) \stackrel{?}{=} x\}$
becomes
 $\mathcal{G} \cup \{x \stackrel{?}{=} f(t_1, \dots, t_m)\}$

decompose

$\mathcal{G} \cup \{f(t_1, \dots, t_m) \stackrel{?}{=} f(u_1, \dots, u_m)\}$
becomes
 $\mathcal{G} \cup \{t_1 \stackrel{?}{=} u_1, \dots, t_m \stackrel{?}{=} u_m\}$

occur-check

$\mathcal{G} \cup \{x \stackrel{?}{=} f(t_1, \dots, t_m)\}$
fails if $x \in vars(f(t_1, \dots, t_m))$

conflict

$\mathcal{G} \cup \{f(t_1, \dots, t_m) \stackrel{?}{=} g(u_1, \dots, u_h)\}$
fails if $f \neq g$ or $m \neq h$

Sintassi IMP

Definition 3.1 (IMP: syntax). The following productions define the syntax of IMP:

$$\begin{array}{lll} a \in Aexp & ::= & n \mid x \mid a_0 + a_1 \mid a_0 - a_1 \mid a_0 \times a_1 \\ b \in Bexp & ::= & v \mid a_0 = a_1 \mid a_0 \leq a_1 \mid \neg b \mid b_0 \vee b_1 \mid b_0 \wedge b_1 \\ c \in Com & ::= & \mathbf{skip} \mid x := a \mid c_0; c_1 \mid \mathbf{if } b \mathbf{ then } c_0 \mathbf{ else } c_1 \mid \mathbf{while } b \mathbf{ do } c \end{array}$$

SOS rules

$$\frac{}{\langle x, \sigma \rangle \rightarrow \sigma(x)} \text{ (ide)}$$

$$\frac{\langle a_0, \sigma \rangle \rightarrow n_0 \quad \langle a_1, \sigma \rangle \rightarrow n_1}{\langle a_0 + a_1, \sigma \rangle \rightarrow n_0 + n_1} \text{ (sum)}$$

$$\frac{\langle a_0, \sigma \rangle \rightarrow n_0 \quad \langle a_1, \sigma \rangle \rightarrow n_1}{\langle a_0 \times a_1, \sigma \rangle \rightarrow n_0 \times n_1} \text{ (prod)}$$

SOS Rules

$$\frac{}{\langle v, \sigma \rangle \rightarrow v} \text{ (bool)}$$

$$\frac{\langle a_0, \sigma \rangle \rightarrow n_0 \quad \langle a_1, \sigma \rangle \rightarrow n_1}{\langle a_0 = a_1, \sigma \rangle \rightarrow (n_0 = n_1)} \text{ (equ)}$$

$$\frac{\langle a_0, \sigma \rangle \rightarrow n_0 \quad \langle a_1, \sigma \rangle \rightarrow n_1}{\langle a_0 \leq a_1, \sigma \rangle \rightarrow (n_0 \leq n_1)} \text{ (leq)}$$

$$\frac{\langle b, \sigma \rangle \rightarrow v}{\langle \neg b, \sigma \rangle \rightarrow \neg v} \text{ (not)}$$

$$\frac{\langle b_0, \sigma \rangle \rightarrow v_0 \quad \langle b_1, \sigma \rangle \rightarrow v_1}{\langle b_0 \vee b_1, \sigma \rangle \rightarrow (v_0 \vee v_1)} \text{ (or)}$$

$$\frac{\langle b_0, \sigma \rangle \rightarrow v_0 \quad \langle b_1, \sigma \rangle \rightarrow v_1}{\langle b_0 \wedge b_1, \sigma \rangle \rightarrow (v_0 \wedge v_1)} \text{ (and)}$$

SOS Rules

$$\frac{}{\langle \text{skip}, \sigma \rangle \rightarrow \sigma} \text{ (skip)}$$

$$\frac{\langle a, \sigma \rangle \rightarrow m}{\langle x := a, \sigma \rangle \rightarrow \sigma[m/x]} \text{ (assign)}$$

$$\frac{\langle c_0, \sigma \rangle \rightarrow \sigma'' \quad \langle c_1, \sigma'' \rangle \rightarrow \sigma'}{\langle c_0; c_1, \sigma \rangle \rightarrow \sigma'} \text{ (seq)}$$

$$\frac{\langle b, \sigma \rangle \rightarrow \text{false} \quad \langle c_1, \sigma \rangle \rightarrow \sigma'}{\langle \text{if } b \text{ then } c_0 \text{ else } c_1, \sigma \rangle \rightarrow \sigma'} \text{ (iff)}$$

$$\frac{\langle b, \sigma \rangle \rightarrow \text{true} \quad \langle c_0, \sigma \rangle \rightarrow \sigma'}{\langle \text{if } b \text{ then } c_0 \text{ else } c_1, \sigma \rangle \rightarrow \sigma'} \text{ (ift)}$$

$$\frac{\langle b, \sigma \rangle \rightarrow \text{true} \quad \langle c, \sigma \rangle \rightarrow \sigma'' \quad \langle \text{while } b \text{ do } c, \sigma'' \rangle \rightarrow \sigma'}{\langle \text{while } b \text{ do } c, \sigma \rangle \rightarrow \sigma'} \text{ (whtt)}$$

$$\frac{\langle b, \sigma \rangle \rightarrow \text{false}}{\langle \text{while } b \text{ do } c, \sigma \rangle \rightarrow \sigma} \text{ (whff)}$$

Semantica denotazione di IMP

$$\mathcal{A} \llbracket n \rrbracket \sigma \stackrel{\text{def}}{=} n$$

$$\mathcal{A} \llbracket x \rrbracket \sigma \stackrel{\text{def}}{=} \sigma x$$

$$\mathcal{A} \llbracket a_0 + a_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{A} \llbracket a_0 \rrbracket \sigma) + (\mathcal{A} \llbracket a_1 \rrbracket \sigma)$$

$$\mathcal{A} \llbracket a_0 - a_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{A} \llbracket a_0 \rrbracket \sigma) - (\mathcal{A} \llbracket a_1 \rrbracket \sigma)$$

$$\mathcal{A} \llbracket a_0 \times a_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{A} \llbracket a_0 \rrbracket \sigma) \times (\mathcal{A} \llbracket a_1 \rrbracket \sigma)$$

$$\mathcal{B} \llbracket v \rrbracket \sigma \stackrel{\text{def}}{=} v$$

$$\mathcal{B} \llbracket a_0 = a_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{A} \llbracket a_0 \rrbracket \sigma) = (\mathcal{A} \llbracket a_1 \rrbracket \sigma)$$

$$\mathcal{B} \llbracket a_0 \leq a_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{A} \llbracket a_0 \rrbracket \sigma) \leq (\mathcal{A} \llbracket a_1 \rrbracket \sigma)$$

$$\mathcal{B} \llbracket \neg b \rrbracket \sigma \stackrel{\text{def}}{=} \neg (\mathcal{B} \llbracket b \rrbracket \sigma)$$

$$\mathcal{B} \llbracket b_0 \vee b_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{B} \llbracket b_0 \rrbracket \sigma) \vee (\mathcal{B} \llbracket b_1 \rrbracket \sigma)$$

$$\mathcal{B} \llbracket b_0 \wedge b_1 \rrbracket \sigma \stackrel{\text{def}}{=} (\mathcal{B} \llbracket b_0 \rrbracket \sigma) \wedge (\mathcal{B} \llbracket b_1 \rrbracket \sigma)$$

$$\mathcal{C} \llbracket \text{skip} \rrbracket \sigma \stackrel{\text{def}}{=} \sigma$$

$$\mathcal{C} \llbracket x := a \rrbracket \sigma \stackrel{\text{def}}{=} \sigma[\mathcal{A} \llbracket a \rrbracket \sigma / x]$$

$$\mathcal{C} \llbracket c_0; c_1 \rrbracket \sigma \stackrel{\text{def}}{=} \mathcal{C} \llbracket c_1 \rrbracket^* (\mathcal{C} \llbracket c_0 \rrbracket \sigma)$$

$$\mathcal{C} \llbracket \text{while } b \text{ do } c \rrbracket = \Gamma_{b,c} \mathcal{C} \llbracket \text{while } b \text{ do } c \rrbracket$$

$$\mathcal{C} \llbracket \text{while } b \text{ do } c \rrbracket \stackrel{\text{def}}{=} \text{fix } \Gamma_{b,c} = \bigsqcup_{n \in \mathbb{N}} \Gamma_{b,c}^n (\perp_{\Sigma \rightarrow \Sigma_\perp})$$

$$\Gamma_{b,c} \stackrel{\text{def}}{=} \lambda \phi. \lambda \sigma. \mathcal{B} \llbracket b \rrbracket \sigma \rightarrow \phi^* (\mathcal{C} \llbracket c \rrbracket \sigma), \sigma$$

Sintassi HOF_L

t	$::=$	x	$ $	n	$ $	$t_0 \text{ op } t_1$	$ $	if t then t_0 else t_1
		(t_0, t_1)		fst (t)		snd (t)		
		$\lambda x. t$		t_0		t_1		
		rec $x. t$						

Sistema di tipi

$$\frac{}{\widehat{x} : \widehat{x}} \qquad \frac{}{n : int} \qquad \frac{t_0 : int \quad t_1 : int}{t_0 \text{ op } t_1 : int} \qquad \frac{t : int \quad t_0 : \tau \quad t_1 : \tau}{\text{if } t \text{ then } t_0 \text{ else } t_1 : \tau}$$

$$\frac{t_0 : \tau_0 \quad t_1 : \tau_1}{(t_0, t_1) : \tau_0 * \tau_1} \qquad \frac{t : \tau_0 * \tau_1}{\text{fst}(t) : \tau_0} \qquad \frac{t : \tau_0 * \tau_1}{\text{snd}(t) : \tau_1}$$

$$\frac{x : \tau_0 \quad t : \tau_1}{\lambda x. t : \tau_0 \rightarrow \tau_1} \qquad \frac{t_1 : \tau_0 \rightarrow \tau_1 \quad t_0 : \tau_0}{t_1 \ t_0 : \tau_1}$$

$$\frac{x : \tau \quad t : \tau}{\text{rec } x. t : \tau}$$