

①

Production
 $T \rightarrow FT'$

$T' \rightarrow *FT'$

$T' \rightarrow \epsilon$

$F \rightarrow ID$

Semantic Rules

$T'.inh = F.val$

$T'.val = T'.syn$

$T'.inh = T'.inh * F.val$

$T'.syn = T'.syn$

$T'.syn = T'.inh$

$F.val = id.lexval$

Synthesized attribs

Thamar Muthu
 Mishra CS4250
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inh = inherited attribute
 syn = synthesized attribute

• Synthesized attribute: takes values from child nodes, S-attributed.

• Inherited attribute: takes values from parent or sibling nodes, L-attributed

Compute weakest precondition

② $a = 2 * b + 1;$ $a = 3 < 0$
 a) $b = a - 3;$ $a < 3$
 $\{b < 0\}$

b) $a = 2 * (b - 1) - 1$ $2 * (b - 1) - 1 > 0$
 $\{a > 0\}$ $2b - 2 - 1 > 0$
 $2b > 3$
 $b > 3/2$

c) if $(a == b)$
 $b = 2 * a + 1;$
 else
 $b = 2 * a;$
 $\{b > 1\}$

~~Not using parenthesis () as above~~
 $2 * a + 1 > 1$ or $2 * a > 1$
 $2a + 1 > 1$ $2a > 0$
 $2a > 0 \Rightarrow a > 0$
 $a > 0$
 $a > 1/2$

$2 * a > 1$
 $a > 1/2$
 rule of consequence pg. 173

d) if $(x > y)$
 $y = 2 * x + 1$
 else
 $y = 3 * x - 1$
 $\{y > 3\}$

$2x + 1 > 3$
 $2x > 2$
 $x > 1$

$3x - 1 > 3$
 $3x > 4$
 $x > 4/3$
 rule of consequence pg. 173

$$3) \quad a^{2n} b^n c^n \quad n \geq 1$$

$$\{ a^4 b^2 c^2, a^6 b^3 c^3, a^8 b^4 c^4, \dots \}$$

$$\langle \text{letter seq} \rangle \rightarrow \langle a \text{ seq} \rangle \langle b \text{ seq} \rangle \langle c \text{ seq} \rangle$$

$$\langle a \text{ seq} \rangle \rightarrow a \mid \langle a \text{ seq} \rangle a$$

$$\langle b \text{ seq} \rangle \rightarrow b \mid \langle b \text{ seq} \rangle b$$

$$\langle c \text{ seq} \rangle \rightarrow c \mid \langle c \text{ seq} \rangle c$$

condition

$$\text{size} \langle a \text{ seq} \rangle^{2n} = \text{size} \langle b \text{ seq} \rangle + \text{size} \langle c \text{ seq} \rangle$$

$$\text{size} \langle b \text{ seq} \rangle = \text{size} \langle c \text{ seq} \rangle$$

$$4) \quad b \quad 0/1/b'0'/b'1' \quad d \quad d'1'/d'2'/\dots/d'9'$$

$$\begin{aligned} K &\Rightarrow V \mid 0 \mid V \\ V &\Rightarrow d \mid \text{var} \\ 0 &\Rightarrow + \mid * \end{aligned}$$

$$mb('0') = 0$$

$$mb('1') = 1$$

$$mb(bin'0') = 2 * mb(bin) + 0$$

$$mb(bin'1') = 2 * mb(bin) + 1$$

$$md('0') = 0$$

$$md('1') = 1$$

$$md(dec'0') = 10 * md(dec) + 0$$

$$md(dec'1') = 10 * md(dec) + 1$$

$$md('9') = 9$$

$$md(dec'9') = 10 * md(dec) + 9$$

(5)

$$\begin{aligned} S &\rightarrow E B E \\ E &\rightarrow V \mid V / V \\ V &\rightarrow b \mid \text{var} \\ \circ &\rightarrow + \mid * \\ B &\rightarrow = \mid ! \mid < \mid > \mid \geq \mid \leq \end{aligned}$$

⑥ CAR grabs first element from the list
 $CAR(a, b, c) \Rightarrow a$
 CDR grabs everything but first element from a list
 $CDR(a, b, c) \Rightarrow b, c$

Define (member atom a - list)
 \downarrow
 2 inputs

(cond

$\{ (null? \text{ a-list}) \#F \}$ ← asking if a-list is null

$\{ (EQ \text{ atom} (CAR \text{ a-list}) \#T) \}$ ← asking if atom = list element of a-list

$\{ (Else (member \text{ atom} (CDDR \text{ a-list}))) \}$

)))

define atom as the remaining elements of a-list that are not the first 2

$f(x)$ definition not bound by an identifier

⑧ $(\text{lambda } (a\ b\ c))$
 $(+ (+ (* a (* x x)) (* b x) c))$

• A lambda expression

⑨ explicit int a
implicit var type binding is done by a compiler.