CS 156 Chapter 5 Extra Slides

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Example 1: Shortcut (backward substitution) (39A)

VC: $\boxed{\underbrace{x \geq 0}_{F} \rightarrow \underbrace{x \geq 0}_{\mathsf{wp}(G,S_1)}}$

$@F: \; x \geq 0$

$x + 1 \geq 1 \qquad i.e. \qquad x \geq 0$

$S_1: \; x := x + 1;$

$x \geq 1$

$@G: \; x \geq 1$

$\Uparrow$

Example 2: Shortcut (backward substitution) (41A)

VC: $$\boxed{\underbrace{\ell \leq i \wedge (\forall j.A[j])}_{F} \ \wedge \ i \leq u \ \wedge \ a[i] = e \rightarrow (\exists j.B[j])}$$

$$@L: \ F: \ \ell \leq i \ \wedge \ \forall j.\underbrace{\ell \leq j < i \rightarrow a[j] \neq e}_{A[j]}$$
$$i \leq u \ \wedge \ a[i] = e \rightarrow (\exists j.B[j])$$

S_1 : assume $i \leq u$;
$$a[i] = e \rightarrow (\exists j.B[j])$$

$\Uparrow$

Example 2: Shortcut (backward substitution), cont. (41B)

S_1 : assume $i \leq u$;

$$a[i] = e \rightarrow (\exists j.B[j])$$

S_2 : assume $a[i] = e$;

$$\text{true} \leftrightarrow (\exists j.B[j]) \qquad i.e. \qquad (\exists j.B[j]))$$

S_3 : $rv := \text{true}$;

$$rv \leftrightarrow (\exists j.B[j])$$

@post G : $rv \leftrightarrow \exists j.\underbrace{\ell \leq j \leq u \ \wedge \ a[j] = e}_{B[j]}$

$\Uparrow$

Example 3: Shortcut (backward substitution) (52A)

VC: $\boxed{i+1 \geq 0 \wedge i-j \geq 0 \wedge j \geq i \rightarrow (i,i) <_2 (i+1, i-j)}$

$$i+1 \geq 0 \wedge i-j \geq 0 \wedge j \geq i \rightarrow (i,i) <_2 (i_0+1, i_0-j_0)$$

$@L_2: \; i+1 \geq 0 \wedge i-j \geq 0$

$$j \geq i \rightarrow (i,i) <_2 (i_0+1, i_0-j_0)$$

$\downarrow L_2: \; (i+1, i-j)$

$$j \geq i \rightarrow (i,i) <_2 (i_0+1, i_0-j_0)$$

assume $j \geq i$;

$$(i,i) <_2 (i_0+1, i_0-j_0)$$

$i := i-1$;

$$(i+1, i+1) <_2 (i_0+1, i_0-j_0)$$

$\downarrow L_1: \; (i+1, i+1)$ $\Uparrow$

Example 3: Shortcut (backward substitution) (52B)

VC: $\boxed{i+1 \geq 0 \wedge i-j \geq 0 \wedge j \geq i \rightarrow (i,i) <_2 (i+1, i-j)}$

$@L_2: \; i+1 \geq 0 \wedge i-j \geq 0$

$j \geq i \rightarrow (i,i) <_2 (i+1, i-j)$

$\downarrow L_2: \; (i+1, i-j)$

$j \geq i \rightarrow (i,i) <_2 \; ?$

assume $j \geq i$;

$(i,i) <_2 \; ?$

$i := i-1$;

$(i+1, i+1) <_2 \; ?$

$\downarrow L_1: \; (i+1, i+1)$ $\Uparrow$