

## COMP 317: Semantics of Programming Languages

# Problem Sheet 3: Solutions



1.  $\langle \text{Program} \rangle ::= \dots \mid \text{for}(\langle \text{Program} \rangle; \langle \text{BooleanExpression} \rangle; \langle \text{Program} \rangle) \{ \langle \text{Program} \rangle \}$

Define  $[[ \text{for}(P1; T; P2) \{ P3 \} ]](S) = [[ P1 ; \text{while } T \text{ do } P3 ; P2 \text{ od} ]](S)$

2.  $\langle \text{Program} \rangle ::= \dots \mid \text{assert } \langle \text{BooleanExpression} \rangle$

Define  $[[ \text{assert } \tau ]](S) = S$  if  $[[ \tau ]](S)$ , and is undefined otherwise.

3.

1.  $\langle \text{CaseList} \rangle ::= \langle \text{Numeral} \rangle : \langle \text{Expression} \rangle \mid \langle \text{Numeral} \rangle : \langle \text{Expression} \rangle ;; \langle \text{CaseList} \rangle$

2.  $\langle \text{Program} \rangle ::= \text{case } \langle \text{Expression} \rangle \text{ of } \langle \text{CaseList} \rangle \text{ endcase}$

3. Define  $[[ M : P ]](N, S) = [[ P ]](S)$  if  $[[ M ]](N) = N$ , and  $= S$  otherwise; and  
 $[[ M : P ;; CL ]](N, S) = [[ P ]](S)$  if  $[[ M ]](N) = N$ , and  $= [[ CL ]](S)$  otherwise.

4. Define  $[[ \text{case } E \text{ of } CL \text{ endcase} ]](S) = [[ CL ]]( [[ E ]](S), S)$ .

5. Extended highlights:

$$\begin{aligned}
 & [[ 'x := 2 ; \text{case } 'x + 1 \text{ of } 0 : 'z := 5 ;; 3 : 'z := 6 ;; 4 : 'y := 0 \text{ endcase} ]](S) \\
 &= [[ \text{case } 'x + 1 \text{ of } 0 : 'z := 5 ;; 3 : 'z := 6 ;; 4 : 'y := 0 \text{ endcase} ]]( [[ 'x := 2 ]](S) ) \\
 &= [[ \text{case } 'x + 1 \text{ of } 0 : 'z := 5 ;; 3 : 'z := 6 ;; 4 : 'y := 0 \text{ endcase} ]](S[ 'x \setminus 2 ]) \\
 &= [[ 0 : 'z := 5 ;; 3 : 'z := 6 ;; 4 : 'y := 0 ]]( [[ 'x + 1 ]](S[ 'x \setminus 2 ]), (S[ 'x \setminus 2 ])) \\
 &= [[ 0 : 'z := 5 ;; 3 : 'z := 6 ;; 4 : 'y := 0 ]](3, (S[ 'x \setminus 2 ])) \\
 &= [[ 3 : 'z := 6 ;; 4 : 'y := 0 ]](3, (S[ 'x \setminus 2 ])) \quad (\text{because } 0 \text{ is not equal to } 3) \\
 &= [[ 'z := 6 ]](S[ 'x \setminus 2 ]) \\
 &= S[ 'x \setminus 2 ][ 'z \setminus 6 ].
 \end{aligned}$$

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