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Facultad de Ciencias Exactas y Naturales - UBA

Práctica 4

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4. Práctica 4

4.1. Ejercicio 1

1. True
2. $\{b \neq 0\}$
3. $\{b \neq 0 \wedge \frac{a}{b} \geq 0\}$
4. $\{0 \leq i < |A|\}$
5. $\{0 \leq i + 2 < |A|\}$
6. True
7. $i \neq |A|$

4.2. Ejercicio 2

Rdo. **Axioma 1 asignación**: $wp(x := E, Q) \equiv def(E) \wedge_L Q^x_E$

1. $\{def(a+1) \wedge_L a + 1 \geq 0\} \equiv \{a \geq -1\}$
2. $\{def(\frac{a}{b}) \wedge_L \frac{a}{b} \geq 0\} \equiv \{b \neq 0 \wedge_L \frac{a}{b} \geq 0\}$
3. $\{def(A[i]) \wedge_L A[i] \geq 0\} \equiv 0 \leq \{i < |A| \wedge_L A[i] \geq 0\}$
4. $\{def(b \cdot b) \wedge_L b \cdot b \geq 0\} \equiv True$
5. $\{def(b+1) \wedge_L a + 1 \geq 0\} \equiv \{True \wedge_L a \geq -1\} \equiv \{a \geq -1\}$

4.3. Ejercicio 3

Rdo. **Axioma 3 secuenciación**: $wp(S1; S2, Q) \equiv wp(S1, wp(S2, Q))$

4.3.A. Pregunta i

$$\begin{aligned} wp(a := a+1; b = \frac{a}{2}, b \geq 0) &\equiv wp(a := a+1, wp(b := \frac{a}{2}, b \geq 0)) \\ &\equiv wp(a := a+1, def(\frac{a}{2}) \wedge_L \frac{a}{2} \geq 0) \\ &\equiv wp(a := a+1, a \geq 0) \\ &\equiv \{def(a+1) \wedge_L a + 1 \geq 0\} \\ &\equiv \{a \geq -1\} \end{aligned}$$

4.3.B. Pregunta ii

$$\begin{aligned} wp(a := A[i] + 1; b := a.a, b \neq 2) &\equiv wp(a := A[i] + 1, wp(b := a.a, b \neq 2)) \\ &\equiv wp(a := A[i] + 1, \{def(a.a) \wedge_L a.a \neq 2\}) \\ &\equiv wp(a := A[i] + 1, \{a \neq \pm\sqrt{2}\}) \\ &\equiv \{def(A[i] + 1) \wedge_L A[i] + 1 \neq \sqrt{2}\} \\ &\equiv \{0 \leq i < |A| \wedge_L A[i] \neq \sqrt{2} - 1\} \end{aligned}$$

4.3.C. Pregunta iii

$$\begin{aligned} wp(a := A[i] + 1; a := b.b, a \geq 0) &\equiv wp(a := A[i] + 1, wp(a := b.b, a \geq 0)) \\ &\equiv wp(a := A[i] + 1, \{def(b.b) \wedge_L b.b \geq 0\}) \\ &\equiv wp(a := A[i] + 1, \{True\}) \\ &\equiv \{def(A[i] + 1) \wedge_L True\} \\ &\equiv \{0 \leq i < |A|\} \end{aligned}$$

4.3.D. Pregunta iv

$$\begin{aligned} wp(a := a - b; b := a + b, (a \geq 0 \wedge b \geq 0)) &\equiv wp(a := a - b, wp(b := a + b, (a \geq 0 \wedge b \geq 0))) \\ &\equiv wp(a := a - b, \{a \geq 0 \wedge a + b \geq 0\}) \\ &\equiv \{a - b \geq 0 \wedge a - b + b \geq 0\} \\ &\equiv \{a \geq b \wedge a \geq 0\} \\ &\equiv \{0 \leq b \leq a\} \end{aligned}$$

4.4. Ejercicio 4

Rdo. **asignación a una secuencia**: $b[i] := E \equiv b := setAt(b, i, E)$

Sea $Q \equiv (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L A[j] \geq 0)$

En todo lo que sigue considero que $|A| \equiv |setAt(A, i, E)|$

Pregunta i

$$\begin{aligned} wp(A[i] := 0, Q) \equiv & wp(setAt(A, i, 0), Q) \\ \equiv & \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L setAt(A, i, 0)[j] \geq 0)\} \\ \equiv & \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i) \longrightarrow_L setAt(A, i, 0)[i] \geq 0) \wedge \\ & ((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L setAt(A, i, 0)[j] \geq 0))\} \\ \equiv & \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i) \longrightarrow_L 0 \geq 0) \wedge \\ & ((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0))\} \\ \equiv & \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0)\} \end{aligned}$$

Pregunta ii

$$
\begin{aligned}
wp(A[i+2] := 0; Q) &\equiv wp(A := setAt(A, i+2, 0), Q) \\
&\equiv \{0 \leq i+2 < |A| \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L setAt(A, i+2, 0)[j] \geq 0)\} \\
&\equiv \{0 \leq i+2 < |A| \wedge_L (\forall j : \mathbb{Z})((0 \leq j < |A| \wedge j = i+2) \longrightarrow_L setAt(A, j, 0)[j] \geq 0 \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i+2) \longrightarrow_L setAt(A, i+2, 0)[j] \geq 0))\} \\
&\equiv \{0 \leq i+2 < |A| \wedge_L (\forall j : \mathbb{Z})((0 \leq j < |A| \wedge j = i+2) \longrightarrow_L 0 \geq 0 \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i+2) \longrightarrow_L A[j] \geq 0))\} \\
&\equiv \{0 \leq i+2 < |A| \wedge_L (\forall j : \mathbb{Z})((0 \leq j < |A| \wedge j \neq i+2) \longrightarrow_L A[j] \geq 0)\}
\end{aligned}
$$

Pregunta iii

$$
\begin{aligned}
wp(A[i+2] := -1, Q) &\equiv wp(A := setAt(A, i+2, -1), Q) \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L setAt(A, i+2, -1)[j] \geq 0)\} \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i+2) \longrightarrow_L -1 \geq 0) \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i+2) \longrightarrow_L A[j] \geq 0))\} \\
&\equiv \{0 \leq i < |A| \wedge_L False\} \\
&\equiv \{False\}
\end{aligned}
$$

Pregunta iv

$$
\begin{aligned}
wp(A[i] := 2 \cdot A[i], Q) &\equiv wp(A := setAt(A, i, 2 \cdot A[i]), Q) \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L setAt(A, i, 2 \cdot A[i])[j] \geq 0)\} \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i) \longrightarrow_L setAt(A, j, 2 \cdot A[j])[j] \geq 0) \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0))\} \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i) \longrightarrow_L A[j] \geq 0) \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0))\} \\
&\equiv \{0 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \wedge \longrightarrow_L A[j] \geq 0)\}
\end{aligned}
$$

Pregunta v

$$
\begin{aligned}
wp(A[i] := A[i-1], Q) &\equiv wp(setAt(A, i, A[i-1]), Q) \\
&\equiv \{(0 \leq i < |A| \wedge 0 \leq i-1 < |A|) \wedge_L (\forall j : \mathbb{Z})(0 \leq j < |A| \longrightarrow_L setAt(A, i, A[i-1])[j] \geq 0)\} \\
&\equiv \{1 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})(((0 \leq j < |A| \wedge j = i) \longrightarrow_L A[j-1] \geq 0) \wedge \\
&\qquad ((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0))\} \\
&\equiv \{1 \leq i < |A| \wedge_L (\forall j : \mathbb{Z})((0 \leq j < |A| \wedge j \neq i) \longrightarrow_L A[j] \geq 0)\}
\end{aligned}
$$