Programming Languages: Imperative Program Construction
Practicals 9: Array Manipulation

Shin-Cheng Mu

Autumn Term, 2021

1. Given $a : \textbf{array}\ [0..10)\ \textbf{of}\ Int$, compute $wp\ (a[i] := 0)\ (a[2] \neq 0)$.
2. Given constant $N, Y : Int$ with $0 \leqslant N$, and variables $b : \textbf{array}\ [0..N)\ \textbf{of}\ Int$, $x, i : Int$,
   (a) compute $wp\ (b[i-1] := x+1)\ \langle \forall j : i \leqslant j < N : b[j] = Y \rangle$.
   (b) Compute $wp\ (b[i-1] := x+1; i := i-1)\ \langle \forall j : i \leqslant j < N : b[j] = Y \rangle$.
3. Derive

   $$\begin{array}{l} \textbf{con}\ N : Int\ \{1 \leqslant N\} \\ \textbf{con}\ F : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ \textbf{var}\ \ h : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ running\_sum \\ \{\langle \forall k : 0 \leqslant k < N : h[k] = \langle \Sigma i : 0 \leqslant i \leqslant k : F[i] \rangle \rangle\}\ . \end{array}$$

4. Derive

   $$\begin{array}{l} \textbf{con}\ N : Int\ \{1 \leqslant N\} \\ \textbf{var}\ \ f\ \ : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ \textbf{con}\ H : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ decompose \\ \{\langle \forall k : 0 \leqslant k < N : H[k] = \langle \Sigma i : 0 \leqslant i \leqslant k : f[i] \rangle \rangle\}\ . \end{array}$$