Programming Languages: Imperative Program Construction
Practicals 6: Loop Constuction II

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Autumn Term, 2021

1. Recall the maximum segment sum problem. What if we want to compute the maximum sum of *non-empty* segments?
   (a) How would you write the specification? Does the specification still make sense with N being constrained only by $0 \leqslant N$?
   (b) Derive a program solving the problem.

2. Recall the derivation of the maximum segment sum problem. Assuming that we had instead used the loop invariant $P_0 \land P_1 \land Q$, where

$$\begin{array}{l} P_0 \equiv r = \langle \uparrow p\ q : 0 \leqslant p \leqslant q \leqslant n : sum\ p\ q \rangle) \quad , \\ P_1 \equiv s = \langle \uparrow p : 0 \leqslant p \leqslant n+1 : sum\ p\ (n+1) \rangle \quad , \\ Q \equiv 0 \leqslant n \leqslant N \quad . \end{array}$$

   Can you construct a program using the invariant above? What if the array is non-empty, that is, $1 \leqslant N$?

3. Derive a solution for:

$$\begin{array}{l} \textbf{con}\ N : Int\{N \geqslant 0\}; a : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ \textbf{var}\ r : Int \\ S \\ \{r = \langle \uparrow i, j : 0 \leqslant i < j < N : a[i] - a[j] \rangle\} \quad . \end{array}$$

4. Derive a solution for:

$$\begin{array}{l} \textbf{con}\ N : Int\{N \geqslant 1\}; a : \textbf{array}\ [0..N)\ \textbf{of}\ Int \\ \textbf{var}\ r : Int \\ S \\ \{r = \langle \# i, j : 0 \leqslant i < j < N : a[i] \times a[j] \geqslant 0 \rangle\} \quad . \end{array}$$