Section 2.1

1. Describe an algorithm that determines the location of the first even integer in a list \(a_1, a_2, \ldots, a_n\) of integers. (If no integer in the list is even, the output should be that the location is 0.)

Solution

\[
\text{location} := 0 \\
\text{for } i := 1 \text{ to } n \\
\text{if } a_i \mod 2 = 0 \text{ then } \text{location} := i
\]

2. Describe an algorithm that takes as input a positive integer \(n\) and gives as output the tens’ digit of \(n\).

Solution

\[
t := n - 100 \left\lfloor \frac{n}{100} \right\rfloor \quad \{ t \text{ is the number consisting of the tens’ and units’ digits of } n \} \\
u := t - 10 \left\lfloor \frac{t}{10} \right\rfloor \quad \{ u \text{ is the units’ digit of } t \} \\
\text{answer} := t - u.
\]

3. Describe an algorithm that takes as input a sequence of distinct integers \(a_1, a_2, \ldots, a_n\) \((n \geq 2)\) and determines if the integers are in increasing order.

Solution

\[
\text{output} := \text{TRUE} \\
\text{for } i := 2 \text{ to } n \\
\text{if } a_{i-1} \geq a_i \text{ then } \text{output} := \text{FALSE}
\]

4. Describe an algorithm that takes as input a list of integers \(a_1, a_2, \ldots, a_n\) \((\text{where } n > 2)\) and determines if some \(a_i\) is equal to the average of an earlier entry in the list and a later entry in the list.
Solution

\[\text{answer} := \text{FALSE}\]
\[i := 2\]
\[\textbf{while} \ \text{answer} = \text{FALSE} \ \textbf{and} \ i < n \ \textbf{do} \]
\[\begin{align*}
&\textbf{begin} \\
&\quad j := 1 \\
&\quad \textbf{while} \ j < i \ \textbf{and} \ \text{answer} = \text{FALSE} \quad \{\text{examine earlier entries in the list}\} \\
&\quad \textbf{begin} \\
&\quad \quad k := i + 1 \\
&\quad \quad \textbf{while} \ k \leq n \ \textbf{and} \ \text{answer} = \text{FALSE} \quad \{\text{examine later entries in the list}\} \\
&\quad \quad \textbf{if} \ a_i = \frac{a_j + a_k}{2} \ \textbf{then} \ \text{answer} := \text{TRUE} \\
&\quad \textbf{end} \\
&\quad \textbf{end} \\
&\textbf{end}
\end{align*}\]