Algorithmic patterns on enumerators

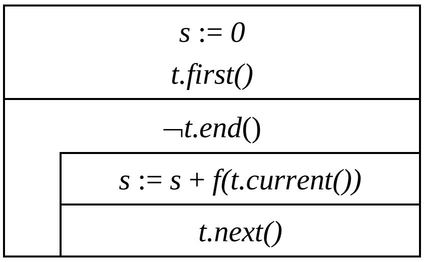
1. Summation

Problem: Let H be an arbitrary set where an associative operation exists, with a left-hand neutral element denoted by *0*. Let us call the operation addition and suppose that its operator is denoted by the + sign. Given an enumerator t enumerating elements of type E and a function $f{:}E \to H$. Let us calculate the sum of the values that f assigns to the elements produced by t.

Specification:

$A = (t{:}enor(E),\ s{:}H)$
$Pre = (t=t')$
$Post = (s = \sum_{e \in t'} f(e))$

Algorithm:



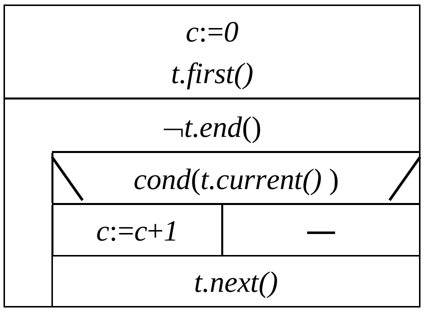
2. Counting

Problem: Given an enumerator t traversing elements from the set E and a logical function $cond{:}E \to \mathbb{L}$. Let us count the elements produced by the enumerator t for which condition *cond* holds.

Specification:

$A = (t{:}enor(E),\ c{:}\mathbb{N})$
$Pre = (t=t')$
$Post = (c = \sum_{\substack{e \in t' \\ cond(e)}} 1)$

Algorithm:



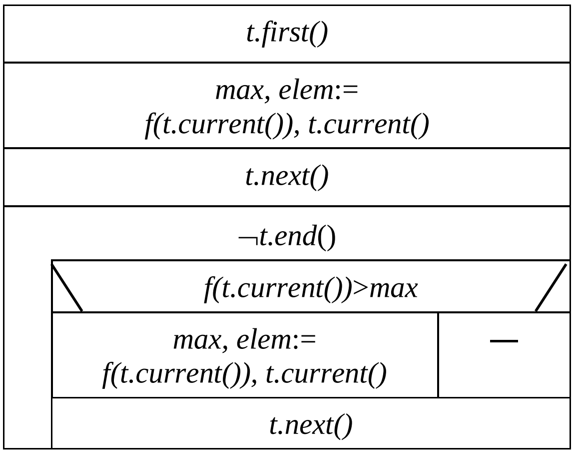
3. Maximum search

Problem: Given a non-empty enumerator t traversing elements from the set E and a function $f{:}E \to H$ where H is a totally ordered set. Let us search the maximal value of the function f where the inputs are the elements of type E that t produces. An element of t to which f assigns the maximal output is also sought.

Algorithm:

Specification:

$A = (t{:}enor(E),\ max{:}H,\ elem{:}E)$
$Pre = (t=t' \wedge |t|>0)$
$Post = ((max, elem) = MAX_{e \in t'} f(e))$



4. Selection

Problem: Given an enumerator t traversing elements from the set E. A logical function $cond$:E→𝕃 is also given. Let us find the first element enumerated by t for which the *cond* condition holds. We can assume that there is such a kind of element produced by t.

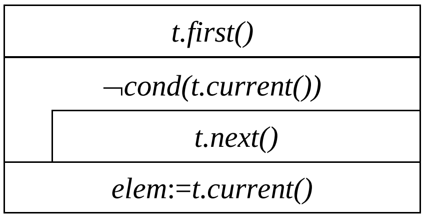
Specification:

$A = (\, t{:}enor(E),\ elem{:}E\,)$

$Pre = (\, t=t' \wedge \exists i\in[1..\,|t|]{:}\ cond(t_i)\,)$

$Post = (\,(elem, t) = SELECT_{e\in t'}\, cond(e)))$

Algorithm:



5. Linear search

Problem: Given an enumerator t traversing elements from the set E. A logical function $cond$:E→𝕃 is also given. Let us find the first element enumerated by t for which the *cond* condition holds.

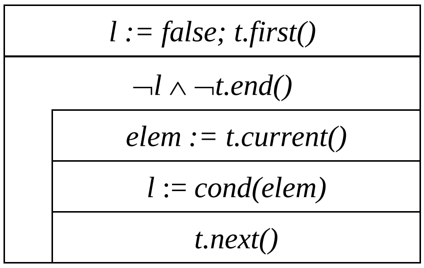
Specification:

$A = (\, t{:}enor(E),\ l{:}\mathbb{L},\ elem{:}E\,)$

$Pre = (\, t=t'\,)$

$Post = (\,(l, elem, t) = SEARCH_{e\in t'}\, cond(e))$

Algorithm:



6. Conditional maximum search

Problem: Given an enumerator t traversing elements from the set E, a logical function $cond$:[$m..n$]→𝕃 and a function $f{:}E\to H$ where H is a totally ordered set. Let us find the maximum value of the function among the outputs where the corresponding element produced by t satisfies the condition *cond*. An element of t to which f assigns the sought maximal value is also has to be determined.

Specification:

$A = (\, t{:}enor(E),\ l{:}\mathbb{L},\ max{:}H,\ elem{:}E\,)$

$Pre = (\, t=t'\,)$

$$Post = (\,(l, max, elem) = \underset{cond(e)}{MAX_{e\in t'}}\, f(e)$$

Algorithm: