Implementation of a vector with an array

Variables

sequence: array of elements
size: integer
invariant: $sequence[0], \ldots, sequence[size-1]$ are the elements of the vector

Initialization

size $\leftarrow 0$

Algorithms

size():
  output: size of vector
return *size*

isEmpty():
  output: vector is empty?
return $(size = 0)$

elemAtRank(*rank*):
  precondition: *rank* is valid[1]
  input: rank of element to be returned
  output: element at *rank*
return $sequence[rank]$

replaceAtRank(*rank*, *element*):
  precondition: *rank* is valid
  postcondition: element at *rank* has been replaced by *element*
  input: rank of element to be replaced and replacement element
  output: replaced element
$temp \leftarrow sequence[rank]$
$sequence[rank] \leftarrow element$
return *temp*

insertAtRank(*rank*, *element*):
  precondition: *rank* is valid or $rank = size$, and *sequence* is not full
  postcondition: *element* has been inserted at *rank*
  input: element to be inserted and rank at which element has to be inserted
move $sequence[rank], \ldots, sequence[size-1]$ one position to the right (1)
$sequence[rank] \leftarrow element$
$size \leftarrow size + 1$
Ad (1):
for $i = size - 1, \ldots, rank$ **do**
    loop-invariant: $\forall j : i < j < size : sequence[j]$ has been moved one position to the right
    $sequence[i+1] \leftarrow sequence[i]$

removeAtRank(*rank*):
  precondition: *rank* is valid
  postcondition: element at *rank* has been removed
  input: rank of the element to be removed
  output: element at *rank*
$temp \leftarrow sequence[rank]$

[1] *rank* is invalid if $rank < 0 \vee rank \geq size$.

move $sequence[rank+1], \ldots, sequence[size-1]$ one position to the left (2)
$size \leftarrow size - 1$
return *temp*

Ad (2):
for $i = rank + 1, \ldots, size - 1$ **do**
    loop-invariant: $\forall j : rank < j < i : sequence[j]$ has been moved one position to the left
    $sequence[i-1] \leftarrow sequence[i]$