Linear probing

Variables

hash-table: array of items, EMPTY and AVAILABLE of size N
hash-function: function from keys to $[0, \ldots, N-1]$
size: integer
invariant: the items of the dictionary are stored in the array *hash-table*; if *hash-table*$[i]$ = (*key*, *element*) then *hash-table*[*hash-function* (*key*)], $\ldots$, *hash-table*$[i-1] \neq$ EMPTY. *size* is the size of the dictionary.

Initialization

```
for $i = 0, \ldots, N-1$
    $\textit{hash-table}[i] \leftarrow$ EMPTY
$\textit{size} \leftarrow 0$
```

Algorithms

```
size():
  output: size of dictionary
return size
```

```
isEmpty():
  output: dictionary is empty?
return ($\textit{size} = 0$)
```

```
findElement(key):
  input: key to be searched for
  output: element of item with key in dictionary; NO-SUCH-KEY if no such item exists
$\textit{number} \leftarrow \textit{hash-function}(\textit{key})$
$\textit{count} \leftarrow 0$
while $\textit{hash-table}[\textit{number}] \neq$ EMPTY and $\textit{count} < N$ and
       ($\textit{hash-table}[\textit{number}] =$ AVAILABLE or key of $\textit{hash-table}[\textit{number}] \neq \textit{key}$) do
    $\textit{number} \leftarrow (\textit{number} + 1) \bmod N$
    $\textit{count} \leftarrow \textit{count} + 1$
if key of $\textit{hash-table}[\textit{number}] = \textit{key}$ then
    return element of $\textit{hash-table}[\textit{number}]$
else
    return NO-SUCH-KEY
```

```
insertItem(key, element):
  input: item to be inserted
  precondition: array hash-table is not full
  postcondition: item (key, element) has been inserted into dictionary
$\textit{number} \leftarrow \textit{hash-function}(\textit{key})$
while $\textit{hash-table}[\textit{number}] \neq$ EMPTY and $\textit{hash-table}[\textit{number}] \neq$ AVAILABLE do
    $\textit{number} \leftarrow (\textit{number} + 1) \bmod N$
$\textit{hash-table}[\textit{number}] \leftarrow (\textit{key}, \textit{element})$
$\textit{size} \leftarrow \textit{size} + 1$
```

```
removeElement($key$):
  input: key to be searched for
  output: element of item with $key$ in dictionary; NO-SUCH-KEY if no such item exists
  postcondition: item has been removed from dictionary
$number \leftarrow hash\text{-}function(key)$
$count \leftarrow 0$
while $hash\text{-}table[number] \neq$ EMPTY and $count < N$ and
      ($hash\text{-}table[number] =$ AVAILABLE or key of $hash\text{-}table[number] \neq key$) do
    $number \leftarrow (number + 1) \bmod N$
    $count \leftarrow count + 1$
if key of $hash\text{-}table[number] = key$ then
    $element \leftarrow$ element of $hash\text{-}table[number]$
    $hash\text{-}table[number] \leftarrow$ AVAILABLE
    $size \leftarrow size - 1$
    return $element$
else
    return NO-SUCH-KEY
```