class $Directory$

types

$KeyType = \mathsf{token};$

$ValueType = \mathsf{token}$

instance variables

$my\text{-}keys : KeyType^* := [];$

$\mathsf{inv\ len}\ my\text{-}keys = count$

$\mathsf{inv}\ \forall\, i, j \in \mathsf{inds}\ my\text{-}keys \cdot$

$i \neq j \ \Rightarrow\ my\text{-}keys\,(i) \neq my\text{-}keys\,(j)$

$my\text{-}values : ValueType^* := [];$

$\mathsf{inv\ len}\ my\text{-}values = count$

$count : \mathbb{N} := 0;$

operations

$getCount : () \xrightarrow{o} \mathbb{N}$

$getCount\,() \triangleq$

$\mathsf{return}\ count;$

$has : KeyType \xrightarrow{o} \mathbb{B}$

$has\,(k) \triangleq$

$\mathsf{return}\ (k \in \mathsf{elems}\ my\text{-}keys);$

$value\text{-}for : KeyType \xrightarrow{o} ValueType$

$value\text{-}for\,(k) \triangleq$

$\mathsf{return}\ my\text{-}values\,(\iota\, i \in \mathsf{inds}\ my\text{-}keys \cdot my\text{-}keys\,(i) = k)$

$\mathsf{pre}\ \ has\,(k)\ ;$

$put : KeyType \times ValueType \xrightarrow{o} ()$

$put\,(k, v) \triangleq$

$($ $my\text{-}keys := my\text{-}keys \curvearrowright [k];$

$my\text{-}values := my\text{-}values \curvearrowright [v];$

$count := count + 1$

$)$

$\mathsf{pre}\ \ \neg\, has\,(k)$

post

$has\,(k) \wedge$

$value\text{-}for\,(k) = v \wedge$

$\mathsf{elems}\ \overleftarrow{my\text{-}keys} \cup \{k\} = \mathsf{elems}\ my\text{-}keys \wedge$

$\forall\, ki \in \mathsf{inds}\ \overleftarrow{my\text{-}keys} \cdot$

$\overleftarrow{my\text{-}values}\,(ki) = value\text{-}for\,(\overleftarrow{my\text{-}keys}\,(ki));$

$remove : KeyType \xrightarrow{o} ()$
$remove\,(k) \triangleq$
(let $length =$ len $my\text{-}keys$ in
let $pos = \iota\, i \in$ inds $my\text{-}keys \cdot my\text{-}keys\,(i) = k$ in
($my\text{-}keys := my\text{-}keys\,(1, \ldots, pos{-}1)^\frown my\text{-}keys\,(pos{+}1, \ldots, length)$;
$my\text{-}values := my\text{-}values\,(1, \ldots, pos{-}1)^\frown my\text{-}values\,(pos{+}1, \ldots, length)$;
$count := count - 1$
)
)
pre $has\,(k)$

post
$\neg\, has\,(k) \wedge$
elems $\overleftarrow{my\text{-}keys} =$ elems $my\text{-}keys \cup \{k\} \wedge$
$\forall\, ki \in$ inds $my\text{-}keys \cdot$
$my\text{-}values\,(ki) = \overleftarrow{my\text{-}values}\,(\iota\, i \in$ inds $\overleftarrow{my\text{-}keys} \cdot$
$\overleftarrow{my\text{-}keys}\,(i) = my\text{-}keys\,(ki))$

end $Directory$