
MODULE *hashmap*

This module describes a *hashmap* to be used for testing with *Shalev et al.*'s split-ordered list implementation of the data structure

EXTENDS *Integers*, *Bags*

CONSTANTS *NULL*, *PossibleKeys*, *PossibleValues*

VARIABLES *keys*, *Hashmap*

Initial state has empty map and all possible values

$$\begin{aligned} \text{Init} \triangleq & \quad \wedge \text{keys} = \text{EmptyBag} \\ & \wedge \text{Hashmap} = [k \in \text{PossibleKeys} \mapsto \text{NULL}] \end{aligned}$$

Insert changes exactly one mapping of the *hashmap*

$$\begin{aligned} \text{Insert} \triangleq & \quad \exists k \in \text{PossibleKeys} : \\ & \quad \exists v \in \text{PossibleValues} : \\ & \quad \wedge \text{keys}' = \text{IF } \text{BagIn}(k, \text{keys}) \text{ THEN } \text{keys} \text{ ELSE } \text{keys} \oplus \text{SetToBag}(\{k\}) \\ & \quad \wedge \text{Hashmap}' = [\text{Hashmap} \text{ EXCEPT } ![k] = v] \end{aligned}$$

Remove sets exactly one mapping to the empty set

$$\begin{aligned} \text{Remove} \triangleq & \quad \exists k \in \text{BagToSet}(\text{keys}) : \\ & \quad \wedge \text{keys}' = \text{keys} \ominus \text{SetToBag}(\{k\}) \\ & \quad \wedge \text{Hashmap}' = [\text{Hashmap} \text{ EXCEPT } ![k] = \text{NULL}] \end{aligned}$$

Next is either an insert or a remove

$$\begin{aligned} \text{Next} \triangleq & \quad \vee \text{Insert} \\ & \vee \text{Remove} \end{aligned}$$

TypeOK asserts all keys are of the right type

$$\begin{aligned} \text{TypeOK} \triangleq & \quad \forall k \in \text{BagToSet}(\text{keys}) : \\ & \quad \wedge k \in \text{PossibleKeys} \\ & \quad \wedge \text{Hashmap}[k] \in \text{PossibleValues} \end{aligned}$$

KeyUnique asserts there are no duplicate keys

$$\text{KeyUnique} \triangleq \forall k \in \text{BagToSet}(\text{keys}) : \text{CopiesIn}(k, \text{keys}) = 1$$

KeyHasValue asserts that every key is mapped to a value

$$\text{KeyHasValue} \triangleq \forall k \in \text{BagToSet}(\text{keys}) : \neg(\text{Hashmap}[k] = \text{NULL})$$
