

COMP3601 - Assignment 2

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MACHINE *Hire*

SETS *ITEMS ; CUSTOMERS*

CONSTANTS *maxitems , bag_total , total_items , number_of_item , bag_union*

PROPERTIES

$$\text{maxitems} \in \mathbb{N} \wedge$$

$$\text{bag_total} \in \text{ITEMS} \rightarrow \mathbb{N}_1 \rightarrow \mathbb{N}_1 \wedge$$

$$\forall bb . (bb \in \text{ITEMS} \rightarrow \mathbb{N}_1 \Rightarrow \text{bag_total} (bb) = \sum zz . (zz \in \text{dom} (bb) \mid bb (zz))) \wedge$$

total number of items hired to a customer

$$\text{total_items} \in (\text{CUSTOMERS} \times \mathbb{N} \rightarrow (\text{ITEMS} \rightarrow \mathbb{N}_1)) \times \text{CUSTOMERS} \rightarrow \mathbb{N} \wedge$$

$$\forall (hh , cc) . ($$

$$hh \in \text{CUSTOMERS} \times \mathbb{N} \rightarrow (\text{ITEMS} \rightarrow \mathbb{N}_1) \wedge$$

$$cc \in \text{CUSTOMERS} \Rightarrow$$

$$\text{total_items} (hh , cc) =$$

$$\sum zz . (zz \in \{ cc \} \triangleleft \text{dom} (hh) \mid \text{bag_total} (\{ zz \} \triangleleft hh (zz))) \wedge$$

total number of specific items on hire

$$\text{number_of_item} \in (\text{CUSTOMERS} \times \mathbb{N} \rightarrow (\text{ITEMS} \rightarrow \mathbb{N}_1)) \times \text{ITEMS} \rightarrow \mathbb{N}_1 \wedge$$

$$\forall (hh , ii) . ($$

$$hh \in \text{CUSTOMERS} \times \mathbb{N} \rightarrow (\text{ITEMS} \rightarrow \mathbb{N}_1) \wedge$$

$$ii \in \text{ITEMS}$$

$$\Rightarrow \text{number_of_item} (hh , ii) = \sum zz . (zz \in \text{dom} (hh) \mid \text{bag_total} (hh (zz))) \wedge$$

merges two bags

$$\text{bag_union} \in (\text{ITEMS} \rightarrow \mathbb{N}_1) \times (\text{ITEMS} \rightarrow \mathbb{N}_1) \rightarrow (\text{ITEMS} \rightarrow \mathbb{N}_1) \wedge$$

$$\forall (ba , bb) . ($$

$$ba \in \text{ITEMS} \rightarrow \mathbb{N}_1 \wedge$$

$$bb \in \text{ITEMS} \rightarrow \mathbb{N}_1$$

$$\Rightarrow \text{bag_union} (ba \mapsto bb) =$$

$$\{ xx , yy \mid xx \in \text{dom} (ba) \cup \text{dom} (bb) \wedge$$

$$yy \in \mathbb{N}_1 \wedge$$

$$yy = \text{bag_total} (\{ xx \} \triangleleft (ba \cup bb)) \}$$

VARIABLES

today , stock , hasHired

INVARIANT

today $\in \mathbb{N} \wedge$

stock $\in \text{ITEMS} \leftrightarrow \mathbb{N} \wedge$

hasHired $\in \text{CUSTOMERS} \times \mathbb{N} \leftrightarrow (\text{dom}(\text{stock}) \leftrightarrow \mathbb{N}_1) \wedge$

customer cannot hire more than maxitems total

$\forall cc . (cc \in \text{CUSTOMERS} \Rightarrow \text{total_items}(\text{hasHired}, cc) \leq \text{maxitems}) \wedge$

cannot hire more items than those in stock

$\forall ii . (ii \in \text{dom}(\text{stock}) \Rightarrow \text{number_of_item}(\text{hasHired}, ii) < \text{stock}(ii))$

INITIALISATION

today , stock , hasHired := 0 , { } , { }

OPERATIONS

Hire given instances of given item to given customer if items are available and customer has not already hired maxitems

hire (item , customer , quantity , duration) $\hat{=}$

PRE

item is valid stock

$item \in \text{dom}(\text{stock}) \wedge$

customer is a customer

$customer \in \text{CUSTOMERS} \wedge$

quantity is greater than none

$quantity \in \mathbb{N}_1 \wedge$

stock is available, that is, quantity is less than or equal to stock on hand minus stock hired

$quantity \leq \text{stock}(item) - \text{number_of_item}(\text{hasHired}, item) \wedge$

customer cannot hire more than maxitems

$\text{total_items}(\text{hasHired}, customer) + quantity \leq \text{maxitems} \wedge$

$duration \in \mathbb{N}$

THEN

add items hired for this customer

$\text{hasHired}(customer \mapsto \text{today} + \text{duration}) :=$

$\text{bag_union}(\text{$

$\{ customer \mapsto \text{today} + \text{duration} \} \triangleleft \text{hasHired}(customer \mapsto \text{today} + \text{duration}),$

$\{ item \mapsto quantity \})$

END ;

Output a subset of hasHired which are overdue items where return date is less than today

oi \leftarrow overdue $\hat{=}$

PRE

nothing to check

true

THEN

io equals all overdue items

oi := dom (hasHired) \triangleright 1 .. today - 1 \triangleleft hasHired

END

END