

## COMP3601 - Assignment 1

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**MACHINE** *Library*

### SETS

*BOOKID* ; *BOOKDESC* ;  
*READERID* ; *READERDESC* ;  
*LOANTYPE*

**CONSTANTS** *maxloans*

**PROPERTIES** *maxloans*  $\in \mathbb{N}$

### VARIABLES

*books* , *readers* , *reserved* , *onLoanTo* , *today* , *loanTypeDuration* ,  
*bookLoanType* , *returnDayOfBook*

### INVARIANT

$books \in BOOKID \leftrightarrow BOOKDESC \wedge$   
 $readers \in READERID \leftrightarrow READERDESC \wedge$   
 $reserved \in \mathbb{P} ( BOOKID ) \wedge$   
 $onLoanTo \in BOOKID \leftrightarrow READERID \wedge$   
 $today \in \mathbb{N} \wedge$   
 $loanTypeDuration \in LOANTYPE \rightarrow \mathbb{N} \wedge$   
 $bookLoanType \in BOOKID \leftrightarrow LOANTYPE \wedge$   
 $returnDayOfBook \in BOOKID \leftrightarrow \mathbb{N} \wedge$   
 $reserved \subseteq \text{dom} ( books ) - \text{dom} ( onLoanTo ) \wedge$   
 $\text{dom} ( onLoanTo ) \subseteq \text{dom} ( books ) \wedge$   
 $\text{ran} ( onLoanTo ) \subseteq \text{dom} ( readers ) \wedge$   
 $\forall rr . ( rr \in \text{dom} ( readers ) \Rightarrow$   
 $\quad \text{card} ( onLoanTo \triangleright \{ rr \} ) \leq \text{maxloans} ) \wedge$   
 $\text{dom} ( bookLoanType ) \subseteq \text{dom} ( books ) \wedge$   
 $\text{dom} ( onLoanTo ) \subseteq \text{dom} ( bookLoanType ) \wedge$   
 $reserved \cap \text{dom} ( bookLoanType ) = \{ \} \wedge$   
 $\text{dom} ( onLoanTo ) = \text{dom} ( returnDayOfBook )$

### INITIALISATION

$books$  ,  $readers$  ,  $reserved$  ,  $onLoanTo$  ,  $today$  ,  $loanTypeDuration$  ,  $bookLoanType$  ,  $returnDayOfBook :=$   
 $\{ \} , \{ \} , \{ \} , \{ \} , 0 , \{ xx , yy \mid xx \in LOANTYPE \wedge yy \in \mathbb{N} \} , \{ \} , \{ \}$

### OPERATIONS

**borrow\_book** ( *bookNo* , *readerNo* )  $\hat{=}$

**PRE**

$bookNo \in \text{dom} ( books ) -$

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    ( reserved  $\cup$  dom ( onLoanTo ) )  $\wedge$ 
    readerNo  $\in$  dom ( readers )  $\wedge$ 
    card ( onLoanTo  $\triangleright$  { readerNo } )  $<$  maxloans  $\wedge$ 
    bookNo  $\in$  dom ( bookLoanType )
THEN
    onLoanTo := onLoanTo  $\Leftarrow$  { bookNo  $\mapsto$  readerNo } ||
    returnDayOfBook := returnDayOfBook  $\Leftarrow$  { bookNo  $\mapsto$  bookLoanType ; loanTypeDuration ( bookNo ) + today }
END ;

remove_book ( bookNo )  $\hat{=}$ 
PRE
    bookNo  $\in$  BOOKID  $\wedge$ 
    bookNo  $\in$  dom ( books )  $\wedge$ 
    bookNo  $\notin$  dom ( onLoanTo )
THEN
    books := { bookNo }  $\Leftarrow$  books ||
    reserved := reserved - { bookNo } ||
    bookLoanType := { bookNo }  $\Leftarrow$  bookLoanType
END ;

add_to_reserve ( bookNo )  $\hat{=}$ 
PRE
    bookNo  $\in$  dom ( books ) - dom ( onLoanTo )  $\wedge$ 
    bookNo  $\notin$  reserved
THEN
    reserved := reserved  $\cup$  { bookNo } ||
    bookLoanType := { bookNo }  $\Leftarrow$  bookLoanType
END ;

new_day  $\hat{=}$ 
PRE
    true
THEN
    today := today + 1
END ;

change_loan_type ( bookNo , newLoanType )  $\hat{=}$ 
PRE
    bookNo  $\in$  dom ( books )  $\wedge$ 
    bookNo  $\notin$  reserved  $\wedge$ 
    newLoanType  $\in$  LOANTYPE
THEN
    bookLoanType := bookLoanType  $\Leftarrow$  { bookNo  $\mapsto$  newLoanType }
END ;

change_duration ( loanType , newDuration )  $\hat{=}$ 
PRE
    loanType  $\in$  LOANTYPE  $\wedge$ 
    newDuration  $\in$   $\mathbb{N}$ 

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THEN
    loanTypeDuration := loanTypeDuration  $\Leftarrow$  { loanType  $\mapsto$  newDuration }
END ;

ob  $\leftarrow$  overdue_books  $\hat{=}$ 
PRE
    true
THEN
    ob := { xx | xx  $\in$  dom ( returnDayOfBook )  $\wedge$  returnDayOfBook ( xx )  $<$  today }  $\triangleleft$  onLoanTo
END

END

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