An Event-B Specification of

Library

This project tests extracting information out from a machine through parameters prefixed with out_.

MACHINE Library $\boxed{1}$

VARIABLES $\boxed{1.1}$

books	All books that are owned by the library.
borrowers	All borrowers registered at the library.
loans	All books that are loaned out.

INVARIANTS

inv1:	$\mathit{books} \in \mathbb{P}(\mathbb{N})$	We represent books
inv2:	$\mathit{borrowers} \in \mathbb{P}(\mathbb{N})$	and borrowers using integers.
inv3:	$\mathit{loans} \in \mathit{books} \mathrel{+\!\!\!\!\!\rightarrow} \mathit{borrowers}$	A book is only loaned to one borrower at a time.

EVENT INITIALISATION

THEN

init1:	$\mathit{books} := \varnothing$
init2:	$\mathit{borrowers} := \varnothing$
init3:	$\mathit{loans} := \varnothing$

END

EVENT addBook $\boxed{1.2}$

Add a new book to the library, the book must not have been added before.

ANY

b

WHERE

grd1:	$b \in \mathbb{N}$
grd2:	$b \notin \mathit{books}$

THEN

act1:	$\mathit{books} := \mathit{books} \cup \{b\}$

END

EVENT addBorrower $\boxed{1.3}$

Add a new borrower to the library, the borrower must not have been added before.

ANY

b

WHERE

grd1:	$b \in \mathbb{N}$
grd2:	$b \notin \mathit{borrowers}$

THEN

act1:	$\mathit{borrowers} := \mathit{borrowers} \cup \{b\}$

END

EVENT addLoan $\boxed{1.4}$

Loan a book to a borrower, the book must not be on loan already.

ANY

borr
book

WHERE

grd1: $borr \in borrowers$ Valid borrower.
grd2: $book \in books$ Valid book.
grd3: $book \mapsto borr \notin loans$ Not a necessary test, but used for this example anyway.
grd4: $book \notin \mathrm{dom}(loans)$ The book is not loaned out already.

THEN

act1: $loans(book) := borr$ Add a new loan in the storage.

END

EVENT returnBook $\boxed{1.5}$

Return a book, the book must be on loan.

ANY

$book$

WHERE

grd1: $book \in books$ Valid book.
grd2: $book \in \mathrm{dom}(loans)$ The book is on loan.

THEN

act1: $loans := \{book\} ⩤ loans$ Remove the loan from storage.

END

EVENT isBookOnLoan $\boxed{1.6}$

Check if a book is on loan.

ANY

$book$
out_onloan

WHERE

grd1: $book \in books$
grd2: $out\_onloan = \mathrm{bool}(book \in \mathrm{dom}(loans))$

END

EVENT whoBorrowsBook $\boxed{1.7}$

Return who is borrowing a book.

ANY

$book$
$out\_borrower$

WHERE

grd1: $book \in books$ Querying a valid book?
grd2: $book \in \mathrm{dom}(loans)$ That is on loan?
grd3: $out\_borrower = loans(book)$ Return the result through out.

END