

# An Event-B Specification of Library

---

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

---

<b>1</b>	<b>MACHINE Library</b>	<b>2</b>
1.1	<i>books borrowers loans</i> . . . . .	2
1.2	<i>addBook(b)</i> . . . . .	2
1.3	<i>addBorrower(b)</i> . . . . .	2
1.4	<i>addLoan(book borr)</i> . . . . .	2
1.5	<i>returnBook(book)</i> . . . . .	3
1.6	<i>isBookOnLoan(book out_onloan)</i> . . . . .	3
1.7	<i>whoBorrowsBook(book out_borrower)</i> . . . . .	3

## VARIABLES

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

EVENT **INITIALISATION**

## THEN

**init1:**     $books := \emptyset$   
**init2:**     $borrowers := \emptyset$   
**init3:**     $loans := \emptyset$

## END

EVENT **addBook**

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:**     $b \notin books$

## THEN

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

## END

EVENT **addBorrower**

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:**     $b \notin borrowers$

## THEN

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

## END

EVENT **addLoan**

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:`  $book \notin \text{dom}(loans)$  The book is not loaned out already.

THEN

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

END

EVENT `returnBook`

1.5

Return a book, the book must be on loan.

ANY

$book$

WHERE

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

THEN

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

END

EVENT `isBookOnLoan`

1.6

Check if a book is on loan.

ANY

$book$

$out\_onloan$

WHERE

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

END

EVENT `whoBorrowsBook`

1.7

Return who is borrowing a book.

ANY

$book$

$out\_borrower$

WHERE

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

END

addBook, 2  
addBorrower, 2  
addLoan, 2  
  
books, 2  
borrowers, 2  
  
INITIALISATION, 2  
isBookOnLoan, 3  
  
Library, 2  
loans, 2  
  
returnBook, 3  
  
whoBorrowsBook, 3