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| **Bug Number** | 2 |
| **Description** | Patron can borrow more items than the set limit for borrowing in one session and can borrow more items if they already have active loans equal to the loan limit. |
| **Pre-conditions** | Remove library.obj, build library from scratch |

# Step 1 : Replication

* This bug can be replicated by running ‘Bug 2 FAT.docx’. Below is an example with sample output (before the bug is resolved):

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| **Step** | **Expected Output/Result** | **Actual** |
| Attempt to borrow 3 Items | Loan limit = 2 Loans.  User cannot borrow 3 items | **Text  Description automatically generated**Patron can borrow 3 items: |
| Attempt to borrow more items while having 3 active loans | Loan limit = 2 Loans.  User cannot borrow more items | Patron can borrow more items:  **Text  Description automatically generated** |

# Step 2 : Simplification

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| **Automated Test** | | Bug2Test |
| **Description** | |  |
| **Required File** | | Bug2Test.java |
| **Set up** |  | |
| **Test** |  | |
| **Result** |  | |

**Bug 2 – Tracing**

**Point of Failure:**

* Patron can borrow more items than the set limit for borrowing in one session.

**Hypothesis 1:**

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| **Description** | Line 59 getNumberofCurrentLoans returns incorrect value |
| **Prediction** | Return currentLoans.size incorrect |
| **Test** | Enter breakpoint:    Then:   1. Take out a loan 2. Borrow another item, complete that loan 3. Borrow another item. |
| **Result** | The currentLoans.size method returns the **correct value**.  After first borrow:    Second borrow: |
| **Conclusion** | Hypothesis is rejected |

**Hypothesis 2:**

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| **Description** | Line 49 Library.canPatronBorrow(patron) returns true when it should return false |
| **Prediction** | Library.canPatronBorrow(patron) returns true after borrowing 2 items, and attempting to borrow a third |
| **Test** | Enter break points:  Line 49: |
| **Result** | Attempt to borrow first item:  canPatronBorrow returns true as it is the first item:  Complete borrowing:    Attempt to borrow 2nd Item. canPatronBorrowReturns true again.    Patron now has 2 loans:    Attempt a third borrow:    canPatronBorrow returns false. |
| **Conclusion** | Hypothesis rejected. |

**Hypothesis 3:**

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| **Description** | From the above debug trace, we now know that the canPatronBorrow method *works* when we try to borrow items using separate transactions.  This means that there is a bug in the program when we try to borrow multiple items within the same transaction.  Thus, line 79 library.getNumberOfLoansRemainingForPatron(patron) - pendingList.size() < 0 contains a logic error. |
| **Prediction** | library.getNumberOfLoansRemainingForPatron(patron) returns correct value  pendingList.size() returns correct value  if (library.getNumberOfLoansRemainingForPatron(patron) - pendingList.size() < 0) is always false. |
| **Test** | Enter breakpoint line 79:    Then run Bug 2 FAT. |
| **Result** | Scan first item and pendingList.size = 1:    Scan second item and pendingList.size = 2:    Scan third item and pendingList.size = 3 while loansRemaining = 2: |
| **Conclusion** | Hypothesis is accepted. |

**Bug 2 – Resolution:**

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| **Solution** | From the debugging trace above, we now know that line 79 is incorrect:    The program only prevents the user from borrowing multiple items in one transaction when the number of remaining loans MINUS the number of items in the current transaction goes BELOW zero. This means that the pending items can be higher than the loan limit and thus demonstrates our bug.  My solution for this is to change the if statement to:    This means that if the pending items are the same as the loan limit (equaling zero) the loan limit will be enforced |
| **Re-test** | To ensure that the bug is resolved, we can run through Bug 2 FAT again. Below is the output from doing so:  Loan Limit of 2 items is enforced PER transaction:      Then if the same patron tries to borrow another item while having 2 loans already they cannot:    (Loans list for patron 1): |