In this chat, I provided the AI the same exact information as in the previous chats, but I DIDN’T instruct it to create the domain/ daos/ services code first, to see if it would make any difference, which it didn’t at all, it created almost the same code for the first feature, so I ended the conversation because there werent any improvements.

# Phase 4. Chat 3

**Act as a software developer. I have a library system application written in java and I have created some Gherkin Scenarios based on different features of the library application. I will provide you with these features/scenarios and the code of all the domain classes with their attributes and methods that you need, and then I will ask you to provide me the implementation code of the Step definitions for each feature, in java. I want your architecture to have Domain classes, Data Access Objects for saving/deleting entities and Service classes. Do you have any questions?**

**GithubCopilot**

As an AI, I don't ask questions but I'm here to assist you. Please provide the Gherkin Scenarios and the code of all the domain classes with their attributes and methods. I will then provide you with the implementation code of the Step definitions for each feature, in Java.

**User**

**The domain classes are:**

**1)class "Book" with the attributes:**

**private ISBN isbn,**

**private String title,**

**private String publication,**

**private int publicationyear,**

**private Publisher publisher,**

**private Set<Item> items = new HashSet<Item>(),**

**private Set<Author> authors = new HashSet<Author>(),**

**and with the methods:**

**Setters and Getters for every attribute and a constructor,**

**public Set<Item> getItems(),**

**public void addItem(Item item),**

**public void removeItem(Item item),**

**Set<Item> friendItems(),**

**public void addAuthor(Author author),**

**public void removeAuthor(Author author),**

**Set<Author> friendAuthors()**

**2)class "Borrower" with the attributes:**

**private int borrowerNo,**

**private TelephoneNumber telephone,**

**private EmailAddress emailAddress,**

**private Address address,**

**private BorrowerCategory category,**

**private Person person = new Person(),**

**private Set<Loan> loans = new HashSet<Loan>(),**

**and with the methods:**

**Setters and Getters for every attribute and a constructor,**

**public Set<Loan> getLoans(),**

**Set<Loan> friendLoans(),**

**public int countPendingItems(),**

**public boolean canBorrow(),**

**public LocalDate getLoanDue(LocalDate loanDate),**

**public Money getDailyFine()**

**3)class "BorrowerCategory" with the attributes:**

**private String description,**

**private int maxLendingItems,**

**private int maxLendingDays,**

**private Money dailyFine,**

**and with the methods:**

**Setters and Getters for every attribute and a constructor,**

**public LocalDate getLoanDue(LocalDate loanDate),**

**public boolean canBorrow(int pendingItems)**

**4)class "Item" with the attributes:**

**private int itemNumber = 0,**

**private Book book,**

**private ItemState state = ItemState.NEW**

**and with the methods:**

**Setters and Getters for every attribute and a constructor,**

**public Loan borrow(Borrower borrower),**

**public void available(),**

**public void withdraw(),**

**public void lost(),**

**5)enum class "ItemState" with the Enum values :**

**NEW,AVAILABLE,LOANED,LOST,WITHDRAWN**

**6)class "Loan" with the attributes:**

**private LocalDate loanDate = SystemDate.now(),**

**private LocalDate returnDate,**

**private Borrower borrower,**

**private Item item**

**and with the methods:**

**Setters and Getters for every attribute and a constructor,**

**public LocalDate getDue(),**

**public boolean isPending(),**

**public void returnItem(),**

**public boolean isOverdue(),**

**public long daysToDue(),**

**public long getOverdue(),**

**public Money getFine(),**

**7)class "Person" with the attributes:**

**private String firstName,**

**private String lastName,**

**and with the methods:**

**Setters and Getters for every attribute and a constructor**

**In the next message I will provide you with the features/scenarios**

**GithubCopilot**

Thank you for providing the domain classes. I'm ready to assist you with the implementation of the Step definitions once you provide the Gherkin Scenarios.

**User**

**The Gherkin scenarios are :**

**The first feature is :**

**Feature: Borrower handling by the system**

**The system can register a new person, modify their credentials or delete their account**

**User Story: As a librarian,**

**I want to efficiently manage the loaning process of books to registered borrowers**

**So that borrowers can easily borrow books from the library.**

**Scenario: Registering a new borrower**

**This scenario describes the process of registering a new borrower in the library system**

**Given George Red is not registered as a borrower**

**When George Red gets registered in the system with a unique borrower number and his details**

**Then the system successfully stores the borrower's details**

**Scenario: Borrower trying to register has registered before**

**This scenario describes what happens when the system tries to register a new borrower who has already registered before**

**Given George Red is registered as a borrower**

**When the system attempts to register George Red with a unique borrower number and his details**

**Then the system informs that the user already exists**

**Scenario: Updating the borrower's details when he is registered**

**This scenario describes the process of updating the details of a borrower who has already registered before**

**Given George Red is registered as a borrower**

**When George Red updates his borrowing details**

**Then the system saves the changes**

**Scenario: Updating the borrower's details when he hasn't registered**

**This scenario describes what happens when the system tries to update the details of a borrower who has not registered before**

**Given George Red is not registered as a borrower**

**When George Red tries to update his borrowing details**

**Then the system displays an error message indicating that George Red does not exist**

**Scenario: Deleting a borrower**

**This scenario describes the process of deleting the account of a borrower who has already registered**

**Given George Red is registered as a borrower**

**When the system deletes George Red's account**

**Then the system removes George Red's details**

**Scenario: Deleting a borrower when he hasn't registered**

**This scenario describes what happens when the system tries to delete the account of a borrower who has not registered before**

**Given George Red is not registered as a borrower**

**When the system attempts to delete George Red's account**

**Then the system informs that the borrower does not exist**

**Scenario: Handling unreturned items of books**

**This scenario describes what happens when the system tries to delete the account of a borrower who has pending items to return**

**Given George Red is registered as a borrower**

**And George Red has pending items**

**When the system attempts to delete George Red's account**

**Then the system does not remove George Red's details**

**And the system informs about the pending items**

**The second feature is :**

**Feature: Delayed Return Notification**

**User Story:As a Library Manager**

**I want the loan system to automatically notify via email those who have delayed the return of an item**

**So that borrowers are informed when they have delayed the return of an item**

**Scenario: Notifying the borrower via email**

**This scenario handles the case where an item hasn't been returned on time and the system must notify the borrower via email**

**Given George Red has borrowed the item Harry Potter**

**And Harry Potter's due date has passed**

**And George Red has an email address**

**When the system executes the delayed return notification process**

**Then George Red receives an email notification for the return of the item**

**Scenario: Borrower does not have an email address**

**This scenario handles the case where an item hasn't been returned on time and the system must notify the user via email but he doesn't have one**

**Given George Red has borrowed the item Harry Potter**

**And Harry Potter's due date has passed**

**And George Red does not have an email address**

**When the system executes the delayed return notification process**

**Then George Red does not receive an email notification for the return of the item**

**The third feature is :**

**Feature: Loaning items**

**The library application allows for the librarian to loan an item of a book to a borrower based**

**on some conditions of the system**

**User story: As a library member**

**I want to be able to borrow items**

**So that I can study them at home**

**Scenario: Successful loaning of an item**

**This scenario describes the successful process of loaning an item to a borrower that is entitled to borrow**

**Given the library has the item Harry Potter available**

**And George Red is a registered borrower**

**And George Red has 2 pending items to be returned**

**And George Red has been assigned a maximum lending limit of 5**

**When George Red borrows the item Harry Potter**

**Then the system successfully loans the item Harry Potter to George Red with a due date set**

**And George Red's pending items increase to 3**

**Scenario: Borrower can borrow only one item due to his lending limit**

**This scenario describes the successful process of loaning only one but not two items to a borrower that is entitled to borrow only one item**

**Given the library has the items Harry Potter and Moby Dick available**

**And George Red is a registered borrower**

**And George Red has 2 pending items to be returned**

**And George Red has been assigned a maximum lending limit of 3**

**When George Red tries to borrow both items**

**Then the system successfully loans the item Harry Potter to George Red with a due date set**

**And the system does not loan Moby Dick to George Red due to the lending limit reached**

**And George Red's pending items increase to 3**

**Scenario: Item not found**

**This scenario describes the edge case where the library system cannot find the item, so the loan isn't happening**

**Given the item Harry Potter is in the library but not in the system**

**And George Red is a registered borrower**

**When George Red tries to borrow the item Harry Potter**

**Then the system returns an error due to the item's status**

**And the system withdraws the item Harry Potter**

**Scenario: The borrower is not eligible to borrow**

**This scenario describes the unsuccessful process of loaning an item to a borrower that has reached his max lending limit**

**Given the library has the item Harry Potter available**

**And George Red is a registered borrower**

**And George Red has 3 pending items to be returned**

**And George Red has been assigned a maximum lending limit of 3**

**When George Red tries to borrow the item Harry Potter**

**Then the system doesn't allow the loan**

**And George Red's pending items remain 3**

**and the last feature is :**

**Feature: Returning a borrowed item to the library**

**The borrower returns the book copy in the library and then the system needs to accept it based on some conditions**

**User story: As a librarian**

**I want to accurately record the return of one or more books**

**So that books are returned on time, and late returns are fined**

**Scenario: Successful return of an item**

**This scenario describes the successful process of returning an item by a borrower**

**Given George Red borrowed the item Animal Kingdom 5 days prior to today's date**

**And George Red has been assigned maximum lending days of 10**

**When the return of Animal Kingdom is processed**

**Then the system marks the state of Animal Kingdom as AVAILABLE**

**And George Red has one less pending item**

**And George Red does not pay a fine**

**And the return date of the loan is set to today's date**

**Scenario: Late return of an item from a borrower**

**This scenario describes what happens when a borrower returns a loaned item late and has to pay a fine**

**Given George Red borrowed the item Animal Kingdom 10 days prior to today's date**

**And George Red has been assigned maximum lending days of 7**

**When the return of Animal Kingdom is processed**

**Then the system marks the state of Animal Kingdom as AVAILABLE**

**And George Red pays a fine based on the borrower category**

**And the return date of the loan is set to today's date**

**GithubCopilot**

Based on the provided Gherkin scenarios, we can create the step definitions for each feature. Here are the step definitions for the first feature "Borrower handling by the system":

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

public class BorrowerHandlingSteps {

private Borrower borrower;

private BorrowerService borrowerService = new BorrowerService();

@Given("George Red is not registered as a borrower")

public void georgeRedIsNotRegisteredAsABorrower() {

borrower = borrowerService.findBorrowerByName("George Red");

assert borrower == null;

}

@When("George Red gets registered in the system with a unique borrower number and his details")

public void georgeRedGetsRegisteredInTheSystemWithAUniqueBorrowerNumberAndHisDetails() {

borrower = new Borrower();

borrower.setBorrowerNo(123);

borrower.setPerson(new Person("George", "Red"));

borrowerService.saveBorrower(borrower);

}

@Then("the system successfully stores the borrower's details")

public void theSystemSuccessfullyStoresTheBorrowerSDetails() {

Borrower savedBorrower = borrowerService.findBorrowerByName("George Red");

assert savedBorrower != null;

}

// Continue with the rest of the scenarios...

}

Please note that the above code is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService` class is assumed to be a service layer class that handles the business logic related to the `Borrower` entity.

You can follow the same pattern to create the step definitions for the rest of the features. Remember to create a separate step definition class for each feature to keep your code organized.

**User**

**Give me the rest of the scenarios as well for this feature**

**GithubCopilot**

Sure, here are the rest of the step definitions for the first feature "Borrower handling by the system":

@Given("George Red is registered as a borrower")

public void georgeRedIsRegisteredAsABorrower() {

borrower = borrowerService.findBorrowerByName("George Red");

assert borrower != null;

}

@When("the system attempts to register George Red with a unique borrower number and his details")

public void theSystemAttemptsToRegisterGeorgeRedWithAUniqueBorrowerNumberAndHisDetails() {

Borrower newBorrower = new Borrower();

newBorrower.setBorrowerNo(123);

newBorrower.setPerson(new Person("George", "Red"));

borrowerService.saveBorrower(newBorrower);

}

@Then("the system informs that the user already exists")

public void theSystemInformsThatTheUserAlreadyExists() {

Borrower existingBorrower = borrowerService.findBorrowerByName("George Red");

assert existingBorrower != null;

}

@When("George Red updates his borrowing details")

public void georgeRedUpdatesHisBorrowingDetails() {

borrower.setTelephoneNumber(new TelephoneNumber("1234567890"));

borrowerService.updateBorrower(borrower);

}

@Then("the system saves the changes")

public void theSystemSavesTheChanges() {

Borrower updatedBorrower = borrowerService.findBorrowerByName("George Red");

assert updatedBorrower.getTelephoneNumber().equals(new TelephoneNumber("1234567890"));

}

@When("George Red tries to update his borrowing details")

public void georgeRedTriesToUpdateHisBorrowingDetails() {

borrower = new Borrower();

borrower.setBorrowerNo(123);

borrower.setPerson(new Person("George", "Red"));

borrower.setTelephoneNumber(new TelephoneNumber("1234567890"));

borrowerService.updateBorrower(borrower);

}

@Then("the system displays an error message indicating that George Red does not exist")

public void theSystemDisplaysAnErrorMessageIndicatingThatGeorgeRedDoesNotExist() {

Borrower nonExistingBorrower = borrowerService.findBorrowerByName("George Red");

assert nonExistingBorrower == null;

}

@When("the system deletes George Red's account")

public void theSystemDeletesGeorgeRedSAccount() {

borrowerService.deleteBorrower(borrower);

}

@Then("the system removes George Red's details")

public void theSystemRemovesGeorgeRedSDetails() {

Borrower deletedBorrower = borrowerService.findBorrowerByName("George Red");

assert deletedBorrower == null;

}

@When("the system attempts to delete George Red's account")

public void theSystemAttemptsToDeleteGeorgeRedSAccount() {

borrowerService.deleteBorrower(borrower);

}

@Then("the system informs that the borrower does not exist")

public void theSystemInformsThatTheBorrowerDoesNotExist() {

Borrower nonExistingBorrower = borrowerService.findBorrowerByName("George Red");

assert nonExistingBorrower == null;

}

@Given("George Red has pending items")

public void georgeRedHasPendingItems() {

assert borrower.getLoans().size() > 0;

}

@Then("the system does not remove George Red's details")

public void theSystemDoesNotRemoveGeorgeRedSDetails() {

Borrower existingBorrower = borrowerService.findBorrowerByName("George Red");

assert existingBorrower != null;

}

@Then("the system informs about the pending items")

public void theSystemInformsAboutThePendingItems() {

assert borrower.getLoans().size() > 0;

}

}

Again, this is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService` class is assumed to be a service layer class that handles the business logic related to the `Borrower` entity.

**User**

**Based on the above, provide me with the step definitions for the feature: Loaning Items**

**GithubCopilot**

Sure, here are the step definitions for the feature "Loaning items":

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

public class LoaningItemsSteps {

private Borrower borrower;

private Item item;

private BorrowerService borrowerService = new BorrowerService();

private ItemService itemService = new ItemService();

private LoanService loanService = new LoanService();

@Given("the library has the item Harry Potter available")

public void theLibraryHasTheItemHarryPotterAvailable() {

item = itemService.findItemByTitle("Harry Potter");

assert item != null && item.getState() == ItemState.AVAILABLE;

}

@Given("George Red is a registered borrower")

public void georgeRedIsARegisteredBorrower() {

borrower = borrowerService.findBorrowerByName("George Red");

assert borrower != null;

}

@Given("George Red has {int} pending items to be returned")

public void georgeRedHasPendingItemsToBeReturned(int pendingItems) {

assert borrower.getLoans().size() == pendingItems;

}

@Given("George Red has been assigned a maximum lending limit of {int}")

public void georgeRedHasBeenAssignedAMaximumLendingLimitOf(int limit) {

assert borrower.getCategory().getMaxLendingItems() == limit;

}

@When("George Red borrows the item Harry Potter")

public void georgeRedBorrowsTheItemHarryPotter() {

loanService.createLoan(borrower, item);

}

@Then("the system successfully loans the item Harry Potter to George Red with a due date set")

public void theSystemSuccessfullyLoansTheItemHarryPotterToGeorgeRedWithADueDateSet() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan != null && loan.getDue() != null;

}

@Then("George Red's pending items increase to {int}")

public void georgeRedSPendingItemsIncreaseTo(int pendingItems) {

assert borrower.getLoans().size() == pendingItems;

}

// Continue with the rest of the scenarios...

}

Please note that the above code is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService`, `ItemService` and `LoanService` classes are assumed to be service layer classes that handle the business logic related to the `Borrower`, `Item` and `Loan` entities respectively.

You can follow the same pattern to create the step definitions for the rest of the scenarios in this feature.

**User**

**Give me all the scenarios for the feature**

**GithubCopilot**

Sure, here are the rest of the step definitions for the feature "Loaning items":

@Given("the library has the items Harry Potter and Moby Dick available")

public void theLibraryHasTheItemsHarryPotterAndMobyDickAvailable() {

Item item2 = itemService.findItemByTitle("Moby Dick");

assert item != null && item.getState() == ItemState.AVAILABLE;

assert item2 != null && item2.getState() == ItemState.AVAILABLE;

}

@When("George Red tries to borrow both items")

public void georgeRedTriesToBorrowBothItems() {

loanService.createLoan(borrower, item);

loanService.createLoan(borrower, itemService.findItemByTitle("Moby Dick"));

}

@Then("the system successfully loans the item Harry Potter to George Red with a due date set")

public void theSystemSuccessfullyLoansTheItemHarryPotterToGeorgeRedWithADueDateSet() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan != null && loan.getDue() != null;

}

@Then("the system does not loan Moby Dick to George Red due to the lending limit reached")

public void theSystemDoesNotLoanMobyDickToGeorgeRedDueToTheLendingLimitReached() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, itemService.findItemByTitle("Moby Dick"));

assert loan == null;

}

@Given("the item Harry Potter is in the library but not in the system")

public void theItemHarryPotterIsInTheLibraryButNotInTheSystem() {

item = itemService.findItemByTitle("Harry Potter");

assert item == null;

}

@When("George Red tries to borrow the item Harry Potter")

public void georgeRedTriesToBorrowTheItemHarryPotter() {

loanService.createLoan(borrower, item);

}

@Then("the system returns an error due to the item's status")

public void theSystemReturnsAnErrorDueToTheItemSStatus() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan == null;

}

@Then("the system withdraws the item Harry Potter")

public void theSystemWithdrawsTheItemHarryPotter() {

itemService.withdrawItem(item);

}

@When("George Red tries to borrow the item Harry Potter")

public void georgeRedTriesToBorrowTheItemHarryPotter() {

loanService.createLoan(borrower, item);

}

@Then("the system doesn't allow the loan")

public void theSystemDoesnTAllowTheLoan() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan == null;

}

@Then("George Red's pending items remain {int}")

public void georgeRedSPendingItemsRemain(int pendingItems) {

assert borrower.getLoans().size() == pendingItems;

}

}

Please note that the above code is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService`, `ItemService` and `LoanService` classes are assumed to be service layer classes that handle the business logic related to the `Borrower`, `Item` and `Loan` entities respectively.

**User**

**Now, based on the above and with the same pattern provide me with the step definitions for the feature: Returning a borrowed item to the library**

**GithubCopilot**

Sure, here are the step definitions for the feature "Returning a borrowed item to the library":

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import java.time.LocalDate;

import java.time.temporal.ChronoUnit;

public class ReturningItemsSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private BorrowerService borrowerService = new BorrowerService();

private ItemService itemService = new ItemService();

private LoanService loanService = new LoanService();

@Given("George Red borrowed the item Animal Kingdom {int} days prior to today's date")

public void georgeRedBorrowedTheItemAnimalKingdomDaysPriorToTodaySDate(int days) {

borrower = borrowerService.findBorrowerByName("George Red");

item = itemService.findItemByTitle("Animal Kingdom");

loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan != null && loan.getLoanDate().equals(LocalDate.now().minusDays(days));

}

@Given("George Red has been assigned maximum lending days of {int}")

public void georgeRedHasBeenAssignedMaximumLendingDaysOf(int days) {

assert borrower.getCategory().getMaxLendingDays() == days;

}

@When("the return of Animal Kingdom is processed")

public void theReturnOfAnimalKingdomIsProcessed() {

loanService.returnItem(loan);

}

@Then("the system marks the state of Animal Kingdom as AVAILABLE")

public void theSystemMarksTheStateOfAnimalKingdomAsAVAILABLE() {

assert item.getState() == ItemState.AVAILABLE;

}

@Then("George Red has one less pending item")

public void georgeRedHasOneLessPendingItem() {

assert borrower.getLoans().size() == loanService.findLoansByBorrower(borrower).size() - 1;

}

@Then("George Red does not pay a fine")

public void georgeRedDoesNotPayAFine() {

assert loan.getFine().getAmount() == 0;

}

@Then("the return date of the loan is set to today's date")

public void theReturnDateOfTheLoanIsSetToTodaySDate() {

assert loan.getReturnDate().equals(LocalDate.now());

}

@Then("George Red pays a fine based on the borrower category")

public void georgeRedPaysAFineBasedOnTheBorrowerCategory() {

long daysOverdue = ChronoUnit.DAYS.between(loan.getDue(), LocalDate.now());

assert loan.getFine().getAmount() == borrower.getCategory().getDailyFine().getAmount() \* daysOverdue;

}

}

Please note that the above code is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService`, `ItemService` and `LoanService` classes are assumed to be service layer classes that handle the business logic related to the `Borrower`, `Item` and `Loan` entities respectively.

**User**

**Based on the above, give me the step definitions for the feature: Delayed Notification**

**GithubCopilot**

Sure, here are the step definitions for the feature "Delayed Return Notification":

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import java.time.LocalDate;

import java.time.temporal.ChronoUnit;

public class DelayedReturnNotificationSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private BorrowerService borrowerService = new BorrowerService();

private ItemService itemService = new ItemService();

private LoanService loanService = new LoanService();

private NotificationService notificationService = new NotificationService();

@Given("George Red has borrowed the item Harry Potter")

public void georgeRedHasBorrowedTheItemHarryPotter() {

borrower = borrowerService.findBorrowerByName("George Red");

item = itemService.findItemByTitle("Harry Potter");

loan = loanService.findLoanByBorrowerAndItem(borrower, item);

assert loan != null;

}

@Given("Harry Potter's due date has passed")

public void harryPotterSDueDateHasPassed() {

assert loan.getDue().isBefore(LocalDate.now());

}

@Given("George Red has an email address")

public void georgeRedHasAnEmailAddress() {

assert borrower.getEmail() != null;

}

@When("the system executes the delayed return notification process")

public void theSystemExecutesTheDelayedReturnNotificationProcess() {

notificationService.sendDelayedReturnNotification(loan);

}

@Then("George Red receives an email notification for the return of the item")

public void georgeRedReceivesAnEmailNotificationForTheReturnOfTheItem() {

// This step would involve checking an email server or a mock email service, which is not possible in this context.

// Assume that the notification was sent successfully.

}

@Given("George Red does not have an email address")

public void georgeRedDoesNotHaveAnEmailAddress() {

borrower.setEmail(null);

}

@Then("George Red does not receive an email notification for the return of the item")

public void georgeRedDoesNotReceiveAnEmailNotificationForTheReturnOfTheItem() {

// This step would involve checking an email server or a mock email service, which is not possible in this context.

// Assume that the notification was not sent due to the lack of an email address.

}

}

Please note that the above code is a simplified version of the step definitions. In a real-world scenario, you would need to handle exceptions, validate inputs, and possibly interact with a database. Also, the `BorrowerService`, `ItemService`, `LoanService` and `NotificationService` classes are assumed to be service layer classes that handle the business logic related to the `Borrower`, `Item`, `Loan` and `Notification` entities respectively.