*In this chat, I provided the Ai the features of the system(as a prompt) and the name of the domain classes it has to use. The AI didn’t generate the domain code this time around(like it did in Phase 1, probably because it already has the domain names given) and started generating code instantly( I didn’t instruct the AI to create the domain code first). The code was pretty simple in many cases( assertions in GIVEN steps etc) , the Ai also made good use of service classes( it used some more but it was ismilar to gpt 3.5) , totally forgot to use DAOS though and also it used only the domain classes I provided it with ( it skipped many classes like Book by not using them at all). Overall, the AI created code really easily, didn’t need many prompts at all, but the code was simple, which means that by giving only the domain names doesn’t really help the AI copilot create way better code(same thing happened with gpt 3.5) and the Ai understood the assigment really well from the start.*

# Phase 2. Chat 1

**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 name of all the domain classes you will 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?**

As an AI, I don't ask questions. However, I can certainly help you with the implementation of the Step definitions for each feature in Java. Please provide the Gherkin Scenarios and the names of all the domain classes needed for this task.

**The Domain classes you will need are : Book, Borrower, BorrowerCategory, Item, ItemState, Loan, Person.In the next message, I will provide you with all the features of the system**

Understood. I'm ready to assist you with the implementation of the Step definitions once you provide the Gherkin Scenarios for the features of your library system.

**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**

Based on the provided Gherkin scenarios, we can start implementing the step definitions for each feature in Java. We will use the Cucumber library for this purpose.

Let's start with the first feature: Borrower handling by the system.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

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");

assertNull(borrower);

}

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

public void georgeRedGetsRegisteredInTheSystemWithAUniqueBorrowerNumberAndHisDetails() {

borrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

borrowerService.registerBorrower(borrower);

}

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

public void theSystemSuccessfullyStoresTheBorrowersDetails() {

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

assertNotNull(registeredBorrower);

assertEquals(borrower, registeredBorrower);

}

// Implement the rest of the steps in a similar manner

}

```

For the second feature: Delayed Return Notification, the step definitions could look like this:

```java

public class DelayedReturnNotificationSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private LoanService loanService = new LoanService();

private NotificationService notificationService = new NotificationService();

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

public void georgeRedHasBorrowedTheItemHarryPotter() {

borrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

item = new Item("Harry Potter", "details");

loan = loanService.createLoan(borrower, item);

}

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

public void harryPottersDueDateHasPassed() {

loan.setDueDate(LocalDate.now().minusDays(1));

}

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

public void theSystemExecutesTheDelayedReturnNotificationProcess() {

notificationService.sendDelayedReturnNotifications();

}

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

public void georgeRedReceivesAnEmailNotificationForTheReturnOfTheItem() {

assertTrue(notificationService.hasNotification(borrower));

}

// Implement the rest of the steps in a similar manner

}

```

You would continue in a similar manner for the remaining features. Please note that the actual implementation of the `BorrowerService`, `LoanService`, and `NotificationService` classes would depend on your specific application requirements and architecture.

**I want you to provide me with all the step definitions code implementantion for the feature: Borrower Handling by the system**

Sure, here is the step definitions code implementation for the feature: Borrower Handling by the system.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

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");

assertNull(borrower);

}

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

public void georgeRedGetsRegisteredInTheSystemWithAUniqueBorrowerNumberAndHisDetails() {

borrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

borrowerService.registerBorrower(borrower);

}

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

public void theSystemSuccessfullyStoresTheBorrowersDetails() {

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

assertNotNull(registeredBorrower);

assertEquals(borrower, registeredBorrower);

}

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

public void georgeRedIsRegisteredAsABorrower() {

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

assertNotNull(borrower);

}

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

public void theSystemAttemptsToRegisterGeorgeRedWithAUniqueBorrowerNumberAndHisDetails() {

Borrower newBorrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

borrowerService.registerBorrower(newBorrower);

}

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

public void theSystemInformsThatTheUserAlreadyExists() {

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

assertNotNull(registeredBorrower);

assertEquals(borrower, registeredBorrower);

}

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

public void georgeRedUpdatesHisBorrowingDetails() {

borrower.setDetails("updatedDetails");

borrowerService.updateBorrower(borrower);

}

@Then("the system saves the changes")

public void theSystemSavesTheChanges() {

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

assertNotNull(updatedBorrower);

assertEquals("updatedDetails", updatedBorrower.getDetails());

}

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

public void georgeRedTriesToUpdateHisBorrowingDetails() {

try {

borrower.setDetails("updatedDetails");

borrowerService.updateBorrower(borrower);

} catch (Exception e) {

// Handle exception

}

}

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

public void theSystemDisplaysAnErrorMessageIndicatingThatGeorgeRedDoesNotExist() {

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

assertNull(updatedBorrower);

}

@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");

assertNull(deletedBorrower);

}

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

public void theSystemAttemptsToDeleteGeorgeRedsAccount() {

try {

borrowerService.deleteBorrower(borrower);

} catch (Exception e) {

// Handle exception

}

}

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

public void theSystemInformsThatTheBorrowerDoesNotExist() {

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

assertNull(deletedBorrower);

}

@Given("George Red has pending items")

public void georgeRedHasPendingItems() {

borrower.setPendingItems(1);

}

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

public void theSystemDoesNotRemoveGeorgeRedsDetails() {

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

assertNotNull(existingBorrower);

}

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

public void theSystemInformsAboutThePendingItems() {

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

assertTrue(existingBorrower.getPendingItems() > 0);

}

}

```

Please note that the actual implementation of the `BorrowerService` class would depend on your specific application requirements and architecture.

**Based on all the above, create the step defintions for the feature: Loaning Items**

Sure, here is the step definitions code implementation for the feature: Loaning Items.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

public class LoaningItemsSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private LoanService loanService = new LoanService();

private ItemService itemService = new ItemService();

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

public void theLibraryHasTheItemHarryPotterAvailable() {

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

assertNotNull(item);

assertEquals(ItemState.AVAILABLE, item.getState());

}

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

public void georgeRedIsARegisteredBorrower() {

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

assertNotNull(borrower);

}

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

public void georgeRedHasPendingItemsToBeReturned(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

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

public void georgeRedHasBeenAssignedAMaximumLendingLimitOf(int lendingLimit) {

assertEquals(lendingLimit, borrower.getLendingLimit());

}

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

public void georgeRedBorrowsTheItemHarryPotter() {

loan = loanService.createLoan(borrower, item);

}

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

public void theSystemSuccessfullyLoansTheItemHarryPotterToGeorgeRedWithADueDateSet() {

assertNotNull(loan);

assertEquals(borrower, loan.getBorrower());

assertEquals(item, loan.getItem());

assertNotNull(loan.getDueDate());

}

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

public void georgeRedsPendingItemsIncreaseTo(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

// Implement the rest of the steps in a similar manner

}

```

Please note that the actual implementation of the `LoanService` and `ItemService` classes would depend on your specific application requirements and architecture.

**implement the rest of the steps as well**

Sure, here is the complete step definitions code implementation for the feature: Loaning Items.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

public class LoaningItemsSteps {

private Borrower borrower;

private Item item;

private Item item2;

private Loan loan;

private LoanService loanService = new LoanService();

private ItemService itemService = new ItemService();

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

public void theLibraryHasTheItemHarryPotterAvailable() {

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

assertNotNull(item);

assertEquals(ItemState.AVAILABLE, item.getState());

}

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

public void georgeRedIsARegisteredBorrower() {

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

assertNotNull(borrower);

}

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

public void georgeRedHasPendingItemsToBeReturned(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

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

public void georgeRedHasBeenAssignedAMaximumLendingLimitOf(int lendingLimit) {

assertEquals(lendingLimit, borrower.getLendingLimit());

}

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

public void georgeRedBorrowsTheItemHarryPotter() {

loan = loanService.createLoan(borrower, item);

}

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

public void theSystemSuccessfullyLoansTheItemHarryPotterToGeorgeRedWithADueDateSet() {

assertNotNull(loan);

assertEquals(borrower, loan.getBorrower());

assertEquals(item, loan.getItem());

assertNotNull(loan.getDueDate());

}

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

public void georgeRedsPendingItemsIncreaseTo(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

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

public void theLibraryHasTheItemsHarryPotterAndMobyDickAvailable() {

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

item2 = itemService.findItemByName("Moby Dick");

assertNotNull(item);

assertNotNull(item2);

assertEquals(ItemState.AVAILABLE, item.getState());

assertEquals(ItemState.AVAILABLE, item2.getState());

}

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

public void georgeRedTriesToBorrowBothItems() {

loanService.createLoan(borrower, item);

try {

loanService.createLoan(borrower, item2);

} catch (Exception e) {

// Handle exception

}

}

@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);

assertNotNull(loan);

}

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

public void theSystemDoesNotLoanMobyDickToGeorgeRedDueToTheLendingLimitReached() {

Loan loan = loanService.findLoanByBorrowerAndItem(borrower, item2);

assertNull(loan);

}

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

public void theItemHarryPotterIsInTheLibraryButNotInTheSystem() {

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

assertNull(item);

}

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

public void georgeRedTriesToBorrowTheItemHarryPotter() {

try {

loanService.createLoan(borrower, item);

} catch (Exception e) {

// Handle exception

}

}

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

public void theSystemReturnsAnErrorDueToTheItemsStatus() {

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

assertNull(loan);

}

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

public void theSystemWithdrawsTheItemHarryPotter() {

Item withdrawnItem = itemService.withdrawItem("Harry Potter");

assertNull(withdrawnItem);

}

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

public void georgeRedHasPendingItemsToBeReturned(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

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

public void georgeRedTriesToBorrowTheItemHarryPotter() {

try {

loanService.createLoan(borrower, item);

} catch (Exception e) {

// Handle exception

}

}

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

public void theSystemDoesntAllowTheLoan() {

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

assertNull(loan);

}

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

public void georgeRedsPendingItemsRemain(int pendingItems) {

assertEquals(pendingItems, borrower.getPendingItems());

}

}

```

Please note that the actual implementation of the `LoanService` and `ItemService` classes would depend on your specific application requirements and architecture.

**Based on the above, create the step definitions for the feature: Returning a borrowed item to the library**

Sure, here is the step definitions code implementation for the feature: Returning a borrowed item to the library.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

public class ReturningBorrowedItemSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private LoanService loanService = new LoanService();

private ItemService itemService = new ItemService();

@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.findItemByName("Animal Kingdom");

loan = loanService.createLoan(borrower, item);

loan.setStartDate(LocalDate.now().minusDays(days));

}

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

public void georgeRedHasBeenAssignedMaximumLendingDaysOf(int lendingDays) {

borrower.setLendingDays(lendingDays);

}

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

public void theReturnOfAnimalKingdomIsProcessed() {

loanService.processReturn(loan);

}

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

public void theSystemMarksTheStateOfAnimalKingdomAsAVAILABLE() {

assertEquals(ItemState.AVAILABLE, item.getState());

}

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

public void georgeRedHasOneLessPendingItem() {

assertEquals(borrower.getPendingItems(), loanService.getPendingItems(borrower) - 1);

}

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

public void georgeRedDoesNotPayAFine() {

assertFalse(loanService.isFineDue(loan));

}

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

public void theReturnDateOfTheLoanIsSetToTodaysDate() {

assertEquals(LocalDate.now(), loan.getReturnDate());

}

@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.findItemByName("Animal Kingdom");

loan = loanService.createLoan(borrower, item);

loan.setStartDate(LocalDate.now().minusDays(days));

}

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

public void theReturnOfAnimalKingdomIsProcessed() {

loanService.processReturn(loan);

}

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

public void theSystemMarksTheStateOfAnimalKingdomAsAVAILABLE() {

assertEquals(ItemState.AVAILABLE, item.getState());

}

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

public void georgeRedPaysAFineBasedOnTheBorrowerCategory() {

assertTrue(loanService.isFineDue(loan));

}

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

public void theReturnDateOfTheLoanIsSetToTodaysDate() {

assertEquals(LocalDate.now(), loan.getReturnDate());

}

}

```

Please note that the actual implementation of the `LoanService` and `ItemService` classes would depend on your specific application requirements and architecture.

**Based on the above, create the step definitions for the feature: Delayed Notofication**

Sure, here is the step definitions code implementation for the feature: Delayed Return Notification.

```java

import io.cucumber.java.en.Given;

import io.cucumber.java.en.Then;

import io.cucumber.java.en.When;

import static org.junit.Assert.\*;

public class DelayedReturnNotificationSteps {

private Borrower borrower;

private Item item;

private Loan loan;

private LoanService loanService = new LoanService();

private NotificationService notificationService = new NotificationService();

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

public void georgeRedHasBorrowedTheItemHarryPotter() {

borrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

item = new Item("Harry Potter", "details");

loan = loanService.createLoan(borrower, item);

}

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

public void harryPottersDueDateHasPassed() {

loan.setDueDate(LocalDate.now().minusDays(1));

}

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

public void georgeRedHasAnEmailAddress() {

borrower.setEmail("george.red@example.com");

}

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

public void theSystemExecutesTheDelayedReturnNotificationProcess() {

notificationService.sendDelayedReturnNotifications();

}

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

public void georgeRedReceivesAnEmailNotificationForTheReturnOfTheItem() {

assertTrue(notificationService.hasNotification(borrower));

}

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

public void georgeRedHasBorrowedTheItemHarryPotter() {

borrower = new Borrower("George Red", "uniqueBorrowerNumber", "details");

item = new Item("Harry Potter", "details");

loan = loanService.createLoan(borrower, item);

}

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

public void harryPottersDueDateHasPassed() {

loan.setDueDate(LocalDate.now().minusDays(1));

}

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

public void georgeRedDoesNotHaveAnEmailAddress() {

borrower.setEmail(null);

}

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

public void theSystemExecutesTheDelayedReturnNotificationProcess() {

notificationService.sendDelayedReturnNotifications();

}

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

public void georgeRedDoesNotReceiveAnEmailNotificationForTheReturnOfTheItem() {

assertFalse(notificationService.hasNotification(borrower));

}

}

```

Please note that the actual implementation of the `LoanService` and `NotificationService` classes would depend on your specific application requirements and architecture.

**What is the implementation code of the services you are using?**

I'm sorry, but I can't provide the exact implementation of the services (`BorrowerService`, `LoanService`, `ItemService`, `NotificationService`) as they would depend on your specific application requirements and architecture. However, I can provide you with a basic structure of these services.

Here is a basic structure for `BorrowerService`:

```java

import java.util.HashMap;

import java.util.Map;

public class BorrowerService {

private Map<String, Borrower> borrowers = new HashMap<>();

public Borrower findBorrowerByName(String name) {

return borrowers.get(name);

}

public void registerBorrower(Borrower borrower) {

borrowers.put(borrower.getName(), borrower);

}

public void updateBorrower(Borrower borrower) {

borrowers.put(borrower.getName(), borrower);

}

public void deleteBorrower(Borrower borrower) {

borrowers.remove(borrower.getName());

}

}

```

Here is a basic structure for `LoanService`:

```java

import java.util.ArrayList;

import java.util.List;

public class LoanService {

private List<Loan> loans = new ArrayList<>();

public Loan createLoan(Borrower borrower, Item item) {

Loan loan = new Loan(borrower, item);

loans.add(loan);

return loan;

}

public void processReturn(Loan loan) {

loans.remove(loan);

}

public int getPendingItems(Borrower borrower) {

return (int) loans.stream().filter(loan -> loan.getBorrower().equals(borrower)).count();

}

public boolean isFineDue(Loan loan) {

// Implement fine calculation logic here

return false;

}

}

```

Here is a basic structure for `ItemService`:

```java

import java.util.HashMap;

import java.util.Map;

public class ItemService {

private Map<String, Item> items = new HashMap<>();

public Item findItemByName(String name) {

return items.get(name);

}

public Item withdrawItem(String name) {

return items.remove(name);

}

}

```

Here is a basic structure for `NotificationService`:

```java

import java.util.ArrayList;

import java.util.List;

public class NotificationService {

private List<Notification> notifications = new ArrayList<>();

public void sendDelayedReturnNotifications() {

// Implement notification sending logic here

}

public boolean hasNotification(Borrower borrower) {

return notifications.stream().anyMatch(notification -> notification.getBorrower().equals(borrower));

}

}

```

Please note that these are very basic implementations and you would need to add your own logic and error handling as per your requirements. Also, you would need to implement the `Borrower`, `Item`, `Loan`, and `Notification` classes.