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TQS: Quality Assurance manual

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1 Project management

1.1 Team and roles

Gabriela : Team Manager + Developer . This member will ensure a fair distribution of tasks, effective backlog management and monitor the pace of the Sprint. Will also support DevOps in case of need.
Diogo : DevOps + Developer. Responsible for the development and production infrastructure, along with the required configurations.
Edgar : Product Owner + Developer. Represents the interests of the stakeholder, by providing insight on the product's features and establishes the acceptance criteria that the developers must follow.
Carolina : Software Quality Assurance Engineer + Developer . Will monitor every phase of the software development process, providing insight on the best QA practices and suggesting regulations for the team to follow. Will also establish the quality gates for accepting a new feature for the product.

1.2 Agile backlog management and work assignment

Overview of the main Agile practices adopted in the project:

- Iterations - Each sprint will take place as a one-week iteration. The goal of the sprint is to increment as much as possible the amount of features included in the product, while taking into account the time restrictions. The product owner establishes the priority for each task, while the team provides input on the number of points for each task and the amount of technical work needed.
- Management of the Product Backlog - The team manager will determine how much work is needed to complete each task by reviewing the points and assigns it to a team member according to their schedule and development strengths. The sequence of the backlog should also reflect the Product Owner's priorities.
- User stories - The scope of the project and its main features are translated into user stories. Each user story will correspond to an entry in the product's backlog. They are described in detail in the Product Specification Report.
- Scrum meetings: We hold the first official meeting every Friday after delivery the previous' sprint results in the practical class and set up the next sprint. Every Wednesday, we also hold a pre-delivery meeting. There are daily updates on the features' progress on Slack by the developers.
- GitHub tracking: Each development branch and associated pull requests should be displayed for the corresponding user story.
- Acceptance criteria: The acceptance criteria for each user story should be written in its description, so that there is a clear metric to evaluate if the feature is ready to be delivered.

Pivotal Tracker was selected as the main project management tool and our project can be accessed in the following link: [https://www.pivotaltracker.com/n/projects/2447537].

The first iteration (I1) of the project consisted of the pre-planning stage and it lasted only a couple of days, thus it was not accounted for as a full sprint in our Pivotal Tracker. Some of the items that were accomplished in the first week were added to the first full sprint for tracking purposes.

Outcome of the first work iteration (May 5 to May 7):

Achievements - I1

1. Product concept was thoroughly developed in the Product Specification Report.
2. Architecture proposal.
3. Orchestration of the main infrastructure (Maven project and DB) using docker containers.
4. Set up of the backlog using Pivotal Tracker, in the form of user stories and epics. Missing only the estimation of each story.
5. Breakdown of the UI and presentation of the first prototypes.

Missing - I1

Nothing. The team is ahead of the sprint's milestones.

Outcome of the second work iteration (May 8 - May 14):

Achievements - I2

1. All the Search API features.
2. First Login API feature.
3. QA Manual is mostly complete (CI/CD section needs to be developed further for the final delivery), nonetheless we were able to deliver a solid draft for this iteration.
4. Architecture section in the Product Specification Report.
5. Web client app infrastructure.
6. Created a mock external publisher to be used as a placeholder in the CD pipeline until the needed endpoints are developed.

Missing - I2

1. Order API features are delayed (Comprador consulta o seu histórico de encomendas + Comprador consulta uma encomenda específica através do seu código).
2. Search UI is underway, we predicted that this would take more than a week from the beginning, since it was dependent on the progress of the Search API being able to deliver working endpoints.

Outcome of the third work iteration (May 15 - May 21):

Achievements - I3

1. All the Order API features.
2. All the Revenue API features.
3. Two Stock API features (Publisher is able to check its stock and update it).
4. New Login API feature (protection of endpoints that require login).
5. Search UI feature was delivered.
6. QA Manual is fully complete.

Missing - I3

1. Failed to present the CI pipeline.
2. The UI features (Orders) that were scheduled for this sprint are fully operational. Nonetheless, they were not officially delivered due to delayed functional testing.

24 points 2 • 15 - 21 May •

- Comprador tenta aceder a uma página para Editoras e vê a sua tentativa a ser negada - API (ED)
  login service
- Comprador consulta o seu histórico de encomendas - API (DS, GA)
  order service
- Comprador consulta uma encomenda específica através do seu código - API (DS, GA)
  order service
- Editora consulta todos os seus livros que se encontram à venda - API (ED)
  stock service
- Editora atualiza o stock de livros para venda - API (ED)
  stock service
- Editora consulta o seu histórico de lucros com vendas na plataforma - API (GA)
  revenue service
- Editora consulta o valor total dos seus lucros com vendas na plataforma - API (GA)
  revenue service
- Comprador faz a encomenda de vários livros - API (GA)
  order service
- Comprador requisita uma estimativa do preço final da sua encomenda - API (GA)
  order service
- Comprador consulta todos os livros que se encontram à venda - UI (CM)
  search service
- Comprador pesquisa por um livro - UI (CM)
- Cliente externo faz reposição periódica de stock (GA)

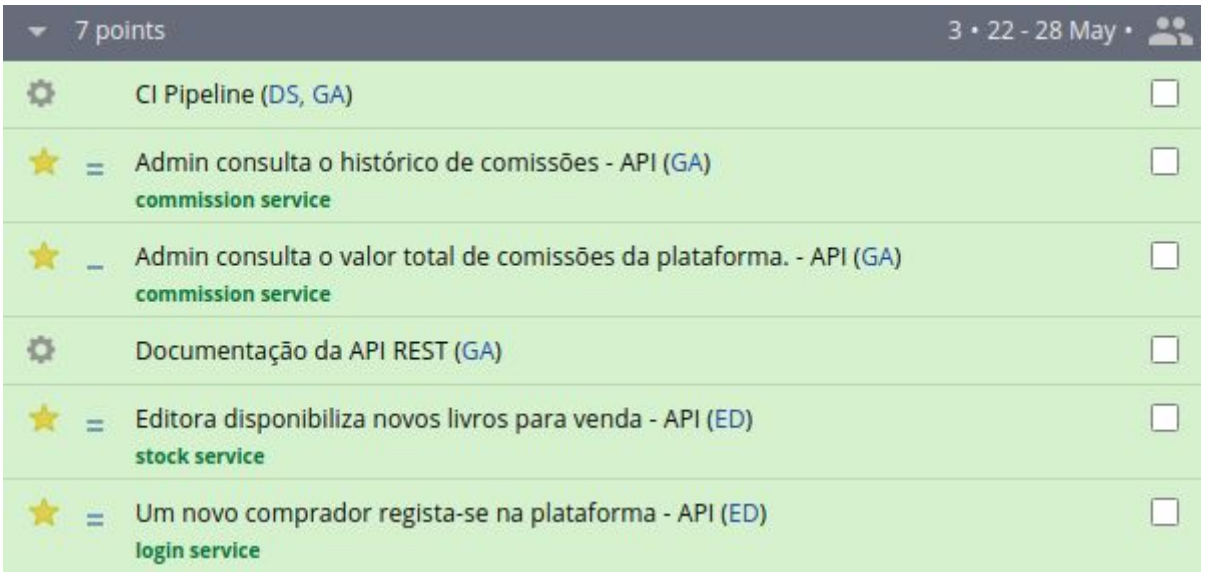
Outcome of the fourth work iteration (May 22 - May 28):

Achievements - I4

1. All the Commission API features.
2. Final Login API feature (Register a new user)
3. Final Stock API feature (Publisher is now able to post new books for sale).
4. Overall, the comprehensive REST API was successfully delivered and documented using Swagger. CI pipeline was set up.

Missing - I4

1. Failed to present the CD pipeline and deployment of services.
2. The UI features of the project are all fully operational, except for registering new users. However, there is a lack of incremental deliveries, due to delayed functional testing.



Outcome of the fifth work iteration (May 29 - June 4):

Achievements - I5

1. CD pipeline is working properly.
2. Final Product was deployed in Heroku.
3. Delivery of all the UI features.
4. Final version of the QA Manual and Product Specification Report.

Missing - I5

Nothing, the team was able to deliver the product successfully.

2 Code quality management

2.1 Guidelines for contributors (coding style)

Coding Style Adopted:

- *Exceptions* :
  - We will not ignore them, always handling them according to the error we will obtain
  - Won't use generic exceptions (ex:Throwable) since this can obscures the failure- handling properties of our code
- *Fully qualify imports*, making it obvious what classes are being used and it makes the code more readable.
- Write *short methods* to keep them small and focused.
- *Fields* will be initialized in standard places (we will initialize them at the top of the page)
- Follow field naming conventions
  - Fields should start with a lowercase letter.
  - Public static final fields (constants) are ALL_CAPS_WITH_UNDERSCORES.

2.2 Code quality metrics

Sonarqube was our option to analyse the code overall performance .

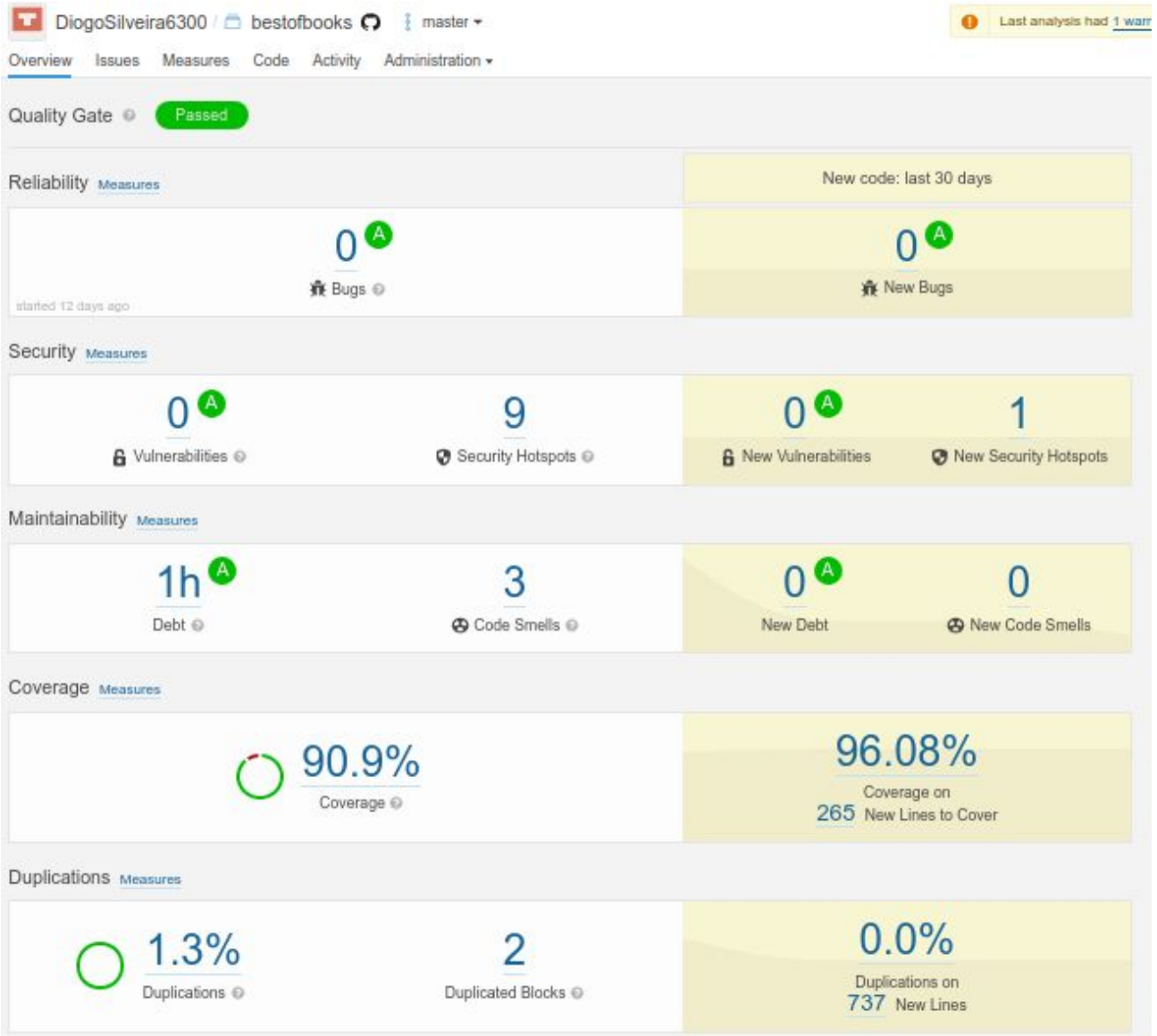
Key aspects that will be taken into account:

- Readability
- Overall Performance
- Usability
- Security
- Maintainability

Quality gates defined for accepting a new feature:

- Minimum unit testing coverage of 80%;
- Fixing critical/ major bugs;
- Critical Vulnerabilities will have to be fixed;
- Critical code smells will be eliminated;
- New code cannot add more than one hour of technical debt to the project (SonarQube tends to overestimate how much time it take to solve an issue) ;
- Security Spots will have to be analysed and will only be fixed if the team agrees to do so.

Final report from SonarQube (from June 4):



The three remaining code smells have been justified in the corresponding pull requests that originated them as technical choices. The first one refers the fact that the Book entity and, thus constructor, has too many fields, but they are needed to fully represent this entity.

The other two mention the overlapping of fields between the OrderDTO and the Order entity, which is also a natural consequence of having a DTO that holds many fields in common with the Order entity.

3 Continuous delivery pipeline (CI/CD)

3.1 Development workflow

We have adopted a Feature-branching workflow with code reviews. Each user story found in Pivotal Tracker has a corresponding development branch in our GitHub repository. As soon as a developer finishes its feature, they create a pull request for the respective branch and assign the rest of the team as reviewers. The link to the pull request is added to the user story in Pivotal Tracker (*Code section*) and the story should be marked as "Delivered". After the team successfully completes the code review process and the feature is officially accepted (and merged to the master branch), the new feature will appear as accepted in the Pivotal Tracker. This tool also attaches the name of each developer to the feature that they will be responsible for, so it also works as record of the delegation of tasks.

The main actors of the code review stage are the Product Owner and the QA Engineer. They are responsible for the assessment of the feature, in terms of meeting the required functionality envisioned by the Product Owner and thoroughly checking if the required quality gates established by the QA engineer have been met. Overall, all the members of the team should comment on the code quality and test the endpoints or user interface by themselves, before approving. SonarQube results should be attached to each pull request. Optionally, attaching a Postman collection with the working endpoints of the feature is also recommend. In the end, most of the interactions regarding the code review process happened on Slack, the team's communication tool, since it would speed up the refactoring process compared to a formal approach of only leaving reviews on the pull request itself.

Definition of done :

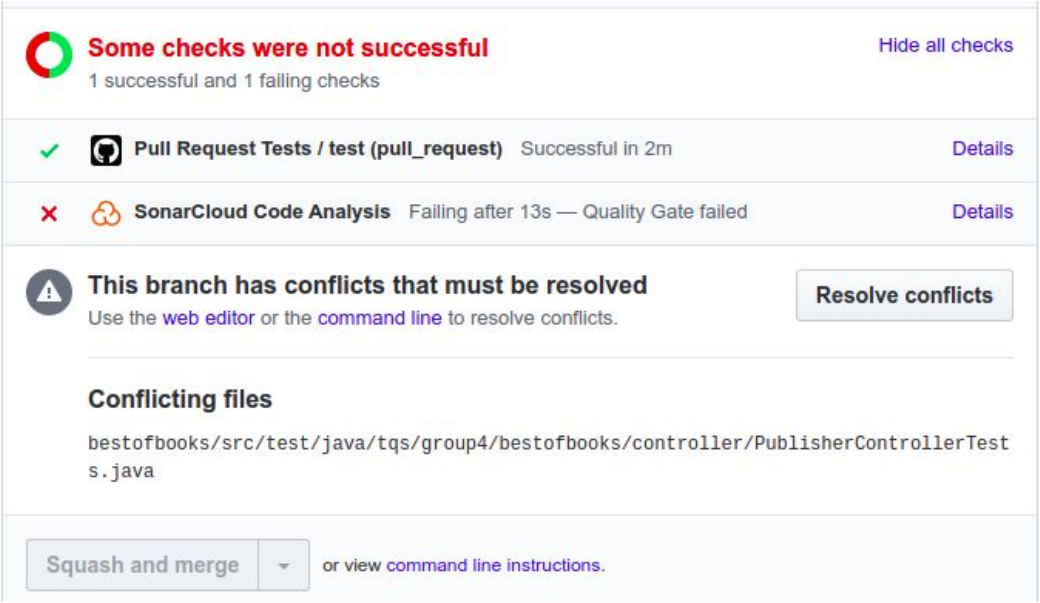
- The user story implementation meets **ALL** the acceptance criteria
- The Product Owner approved the user story
- The user story has been peer-reviewed
- Every acceptance criteria has a corresponding test case
- The quality gate requirements from section 2.2 have been met and approved by the QA engineer.

3.2 CI/CD pipeline and tools

CI practices:

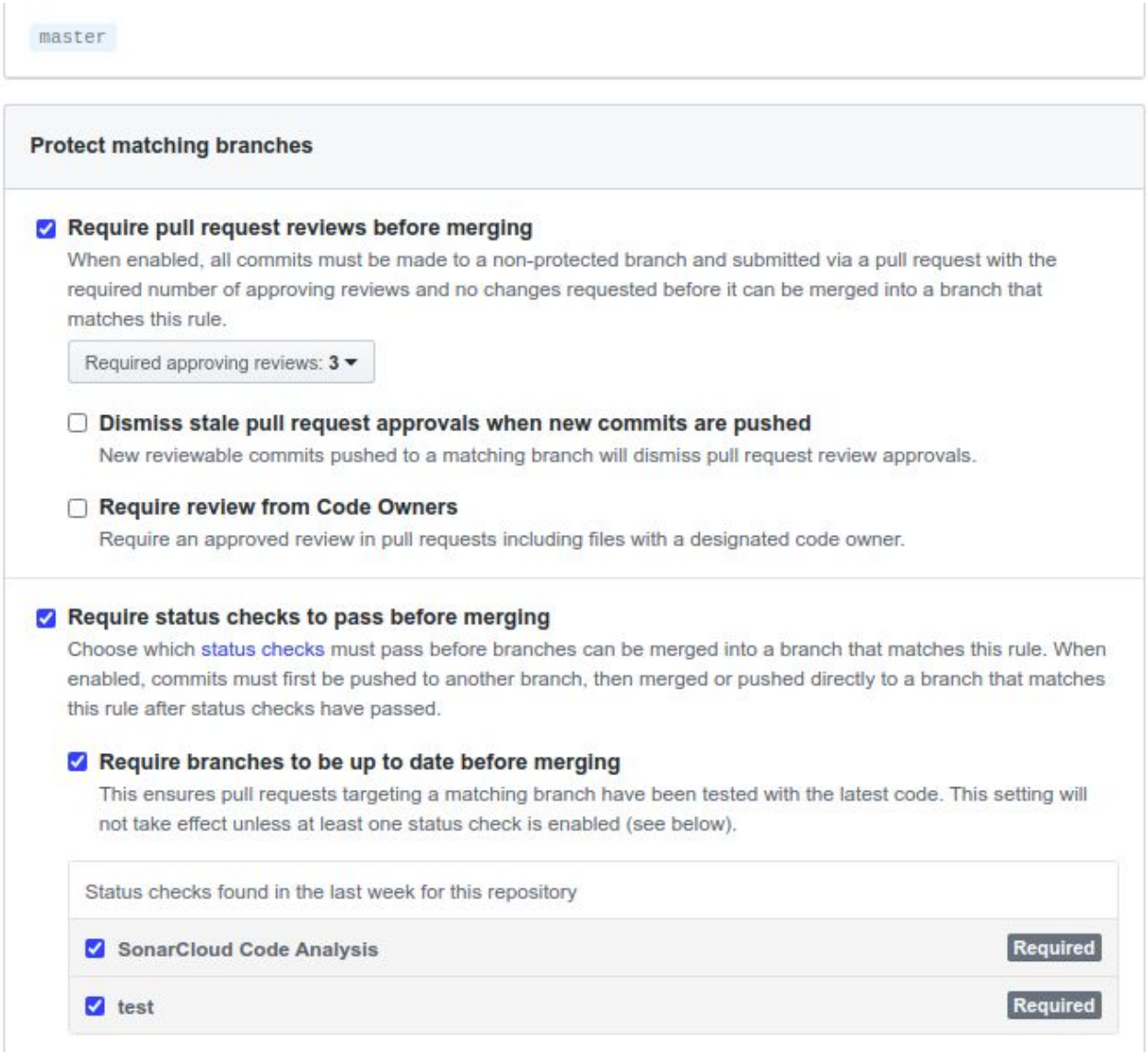
The main goal is to guarantee that the code found in the master branch of our GitHub repository always corresponds to a Minimum Viable Product that is ready to be deployed. To achieve that and make sure that our incremental approach to development is working properly, it is extremely important that the code that is accepted after a pull request is thoroughly tested before any merging occurs.

In order to automate the QA reviews of the project, every pull request and push to the master should be run through the CI pipeline, which will trigger all the corresponding tests and a static code analysis ran by SonarCloud. A failing test or code quality metric should invalidate the acceptance of the pull request until the issue is solved by the developer, as we can see below that the merge option is deactivated:

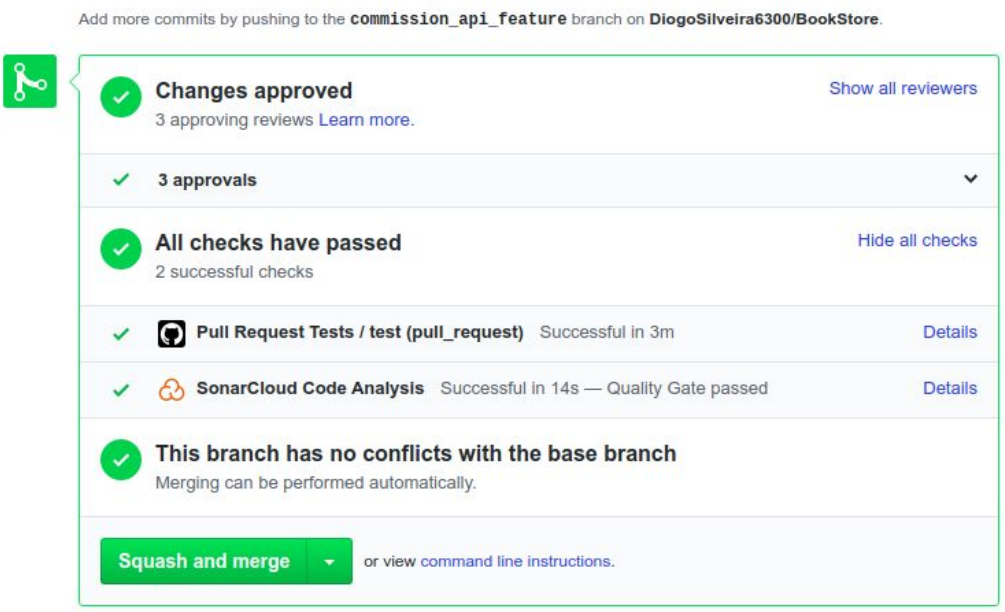


The master branch is protected through 3 different rules for a pull request:

- 3 reviews from the rest of the development team are required;
- The branch that integrates the pull request from be up to date with the content of the master;
- The branch that integrates the pull request needs to pass 2 different checks (one corresponding to passing all the unit, functional and integration tests and the second one related to passing Sonar Cloud's Quality Gate).

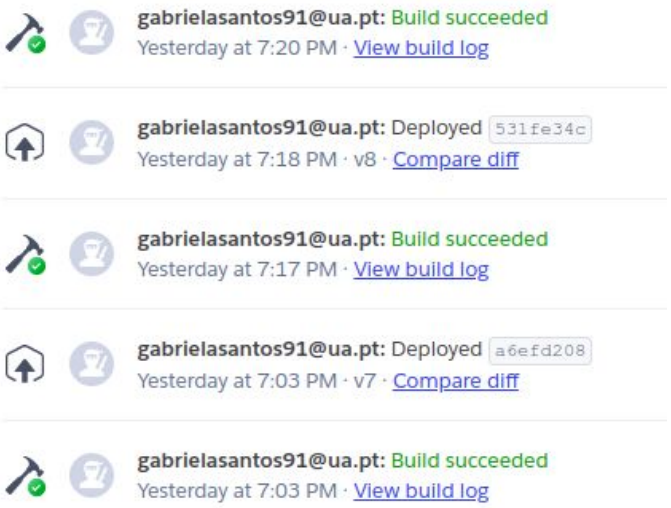


Therefore, a successful pull request should look this:

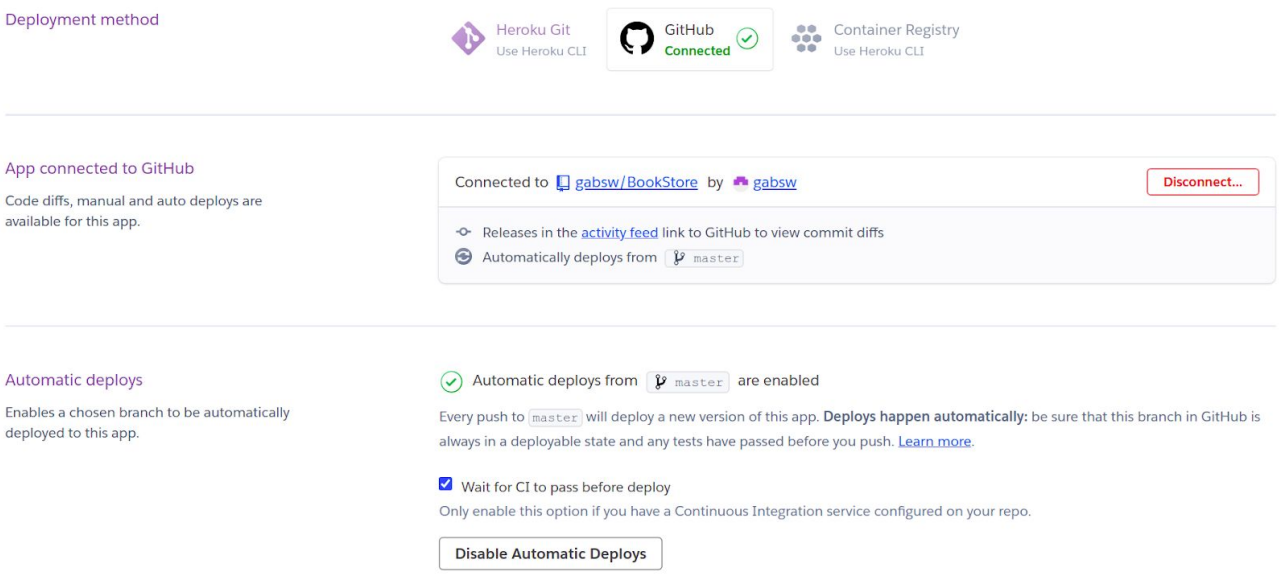


CI pipeline and tools : Github Actions and SonarCloud

CD practices:
To automate our software release cycle, we will be relying on a workflow that is triggered by each new increment of the product's features that is accepted after a pull request or push and is merged into the master branch, where the Minimum Viable Product is contained. Our aim is to reduce the waiting time between each release, so that our product is constantly updated. Nevertheless, it is crucial that the product is able to maintain a stable state for its clients. Developers should not introduce manual changes to the production code that did not went through the CD pipeline. Each new increment in the master branch of GitHub will thus generate an automatic build of a Dyno container and deploy in Heroku:

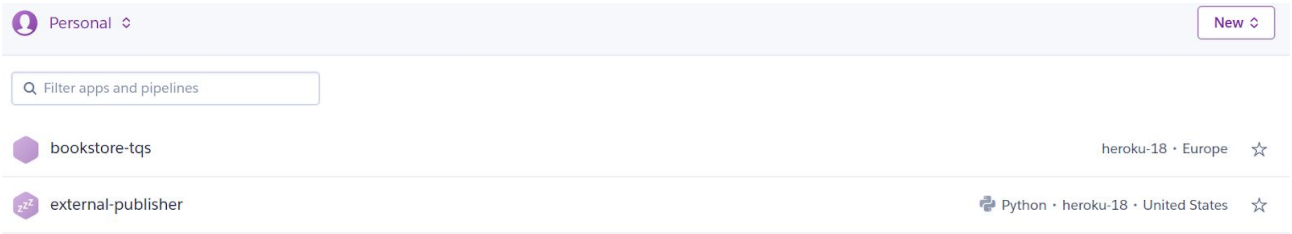


Deployments will only be allowed after the new code entry is able to pass the CI pipeline, as we can see in the configurations below:

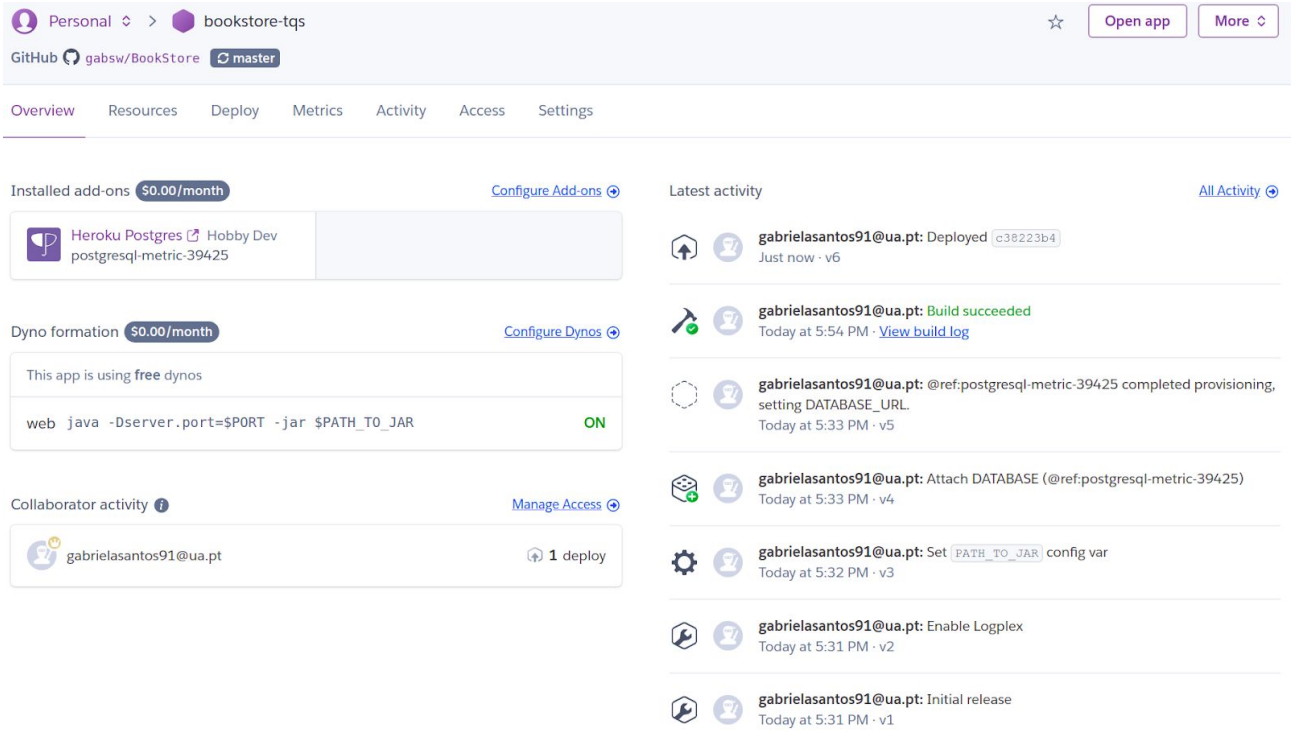


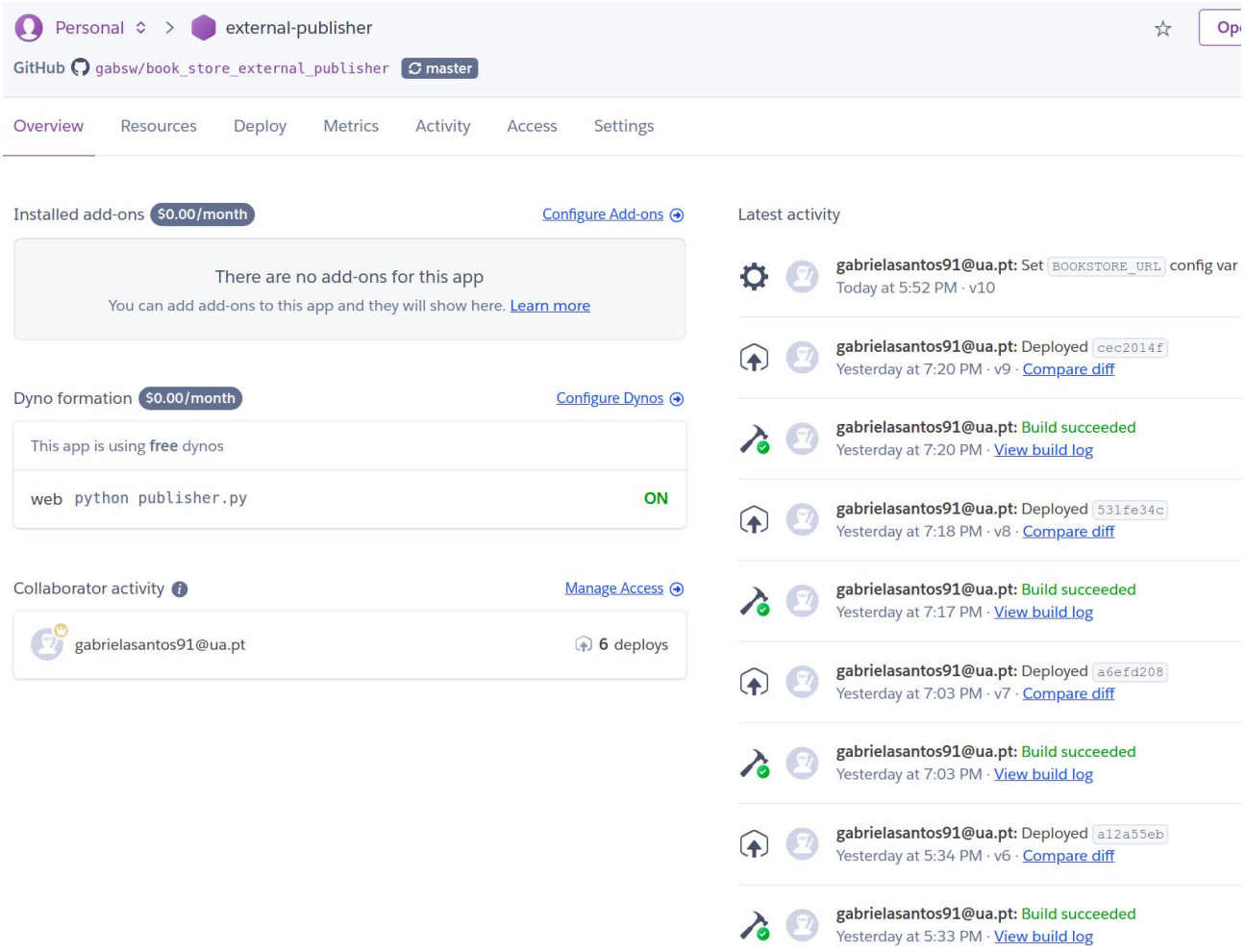
Our project can be divided into the following two self-contained applications: the marketplace application (the client UI application is contained in the same Maven project as the marketplace and will be served from there) and the external publisher application. Each one of them will be deployed into separated dynos (which are Linux containers) that will be deployed to an Heroku server environment. Containerizing each application ensures that they will behave the same, without relying on any machine-specific configuration for them to work properly. The PostgreSQL database was also deployed as a separate service: an Heroku add-on, which is a free service for hosting a DB with less than 10 000 rows.

The two different containers can be seen below:



The dyno corresponding to the main application is connected to the database service, as we can see below, along with the deployment history:





CD pipeline and tools : GitHub Actions and Heroku

4 Software testing

1.1 Overall strategy for testing

For a typical API feature, the testing strategy consists of the following steps, in order:

- Unit tests without mocking using Junit5 (mainly for Model objects);
- Unit tests with dependency isolation using Mockito and Junit5 (for services);
- Unit tests for controllers using Mockito, MockMvc and Junit5;
- Integration tests for the repositories using Junit5. We want to properly test our repository methods against a replica of the production database, which could be counted as integration. However, the repository is being tested in isolation without any other components. This methodology will help us in terms of detecting any problems with the repositories early on, before ta full integration test;
- Full integration tests for the controller-service-repository pipeline with MockMvc and Junit5.

Before each step, running a static code analysis with SonarQube is recommended, in order to check the levels of code coverage and the impacts of refactoring the implementation code.

For a typical UI feature, the testing strategy consists of running functional tests with Selenium WebDriver and Junit5.

Overall, a developer that is responsible for a feature will write all the tests themselves, so that we can optimize the time spent on testing on the person that is most familiar with the content of the implementation code.

In terms of TDD, we decided not to follow its key principle, which would be writing unit tests before implementing code. The reason lies on the fact that the timeframe for implementing the project is very short, so we needed to figure out the implementation details as we go, since we don't have a long pre-planning stage to write all the entities and methods of the problem as a team. Nonetheless, we aim to accomplish a detrimental TDD guideline, which is trying to develop with testing in mind. Our methods should be succinct and without complex control statements. We also spent a considerable amount of time modelling the project's entities and choosing how would the services work so that they could be easily tested.

Regarding BDD, we opted not to use Cucumber. Adopting a cost-benefit perspective, we did not think that we had a lot to gain from using natural-language constructs to test the project with the given timeframe for delivery. Furthermore, we consider that this tool would be more appropriate when working within a larger group of people that have varying levels of knowledge of the technical aspects of the implementation code, for example, people from management backgrounds, which was not the case here. By having adopted a peer code review methodology, we also feel that everyone on the team has a good overall understanding of the implementation code.

1. Functional testing/acceptance

Functional tests should be written using a black box approach, which means that the inner workings of the implementation code that is being tested are unknown to the tester. Therefore, the tester should assume a user perspective, even if they are person that actually wrote the code.

Policy for functional testing:

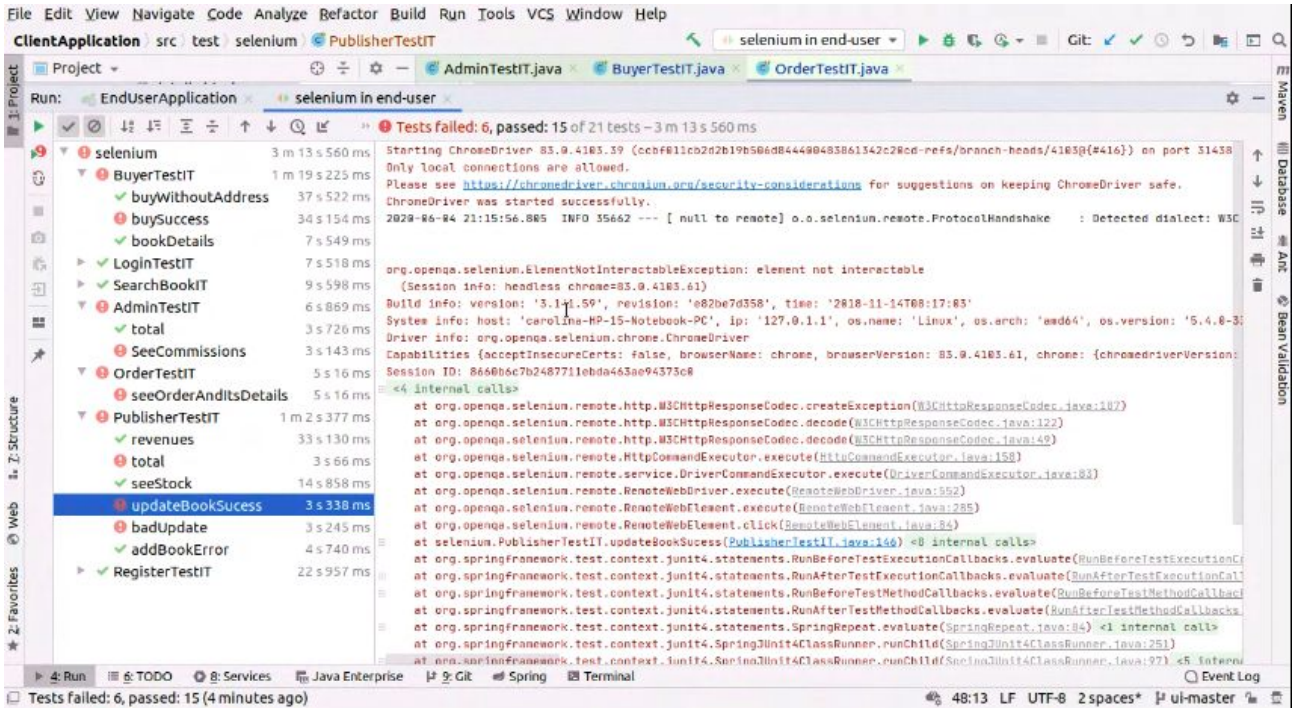
The goal of these tests is to simulate the typical handling of the interface of the marketplace by a real-life user. These tests should portray the use cases that were described in the Product Specification Report and they should verify if the system is fully compliant. Selenium WebDriver is going to used as the tool to test the behavior of the interface with a Chrome. In order to make the testing process more efficient, the Selenium tests should work in headless mode and be a full SpringBootTest running on a web environment.

It is very important that the names of the testing methods correctly describe the intent of each test. The name of the class that contains these tests should end with “IT”. They should be stored in a separate package called “selenium”.

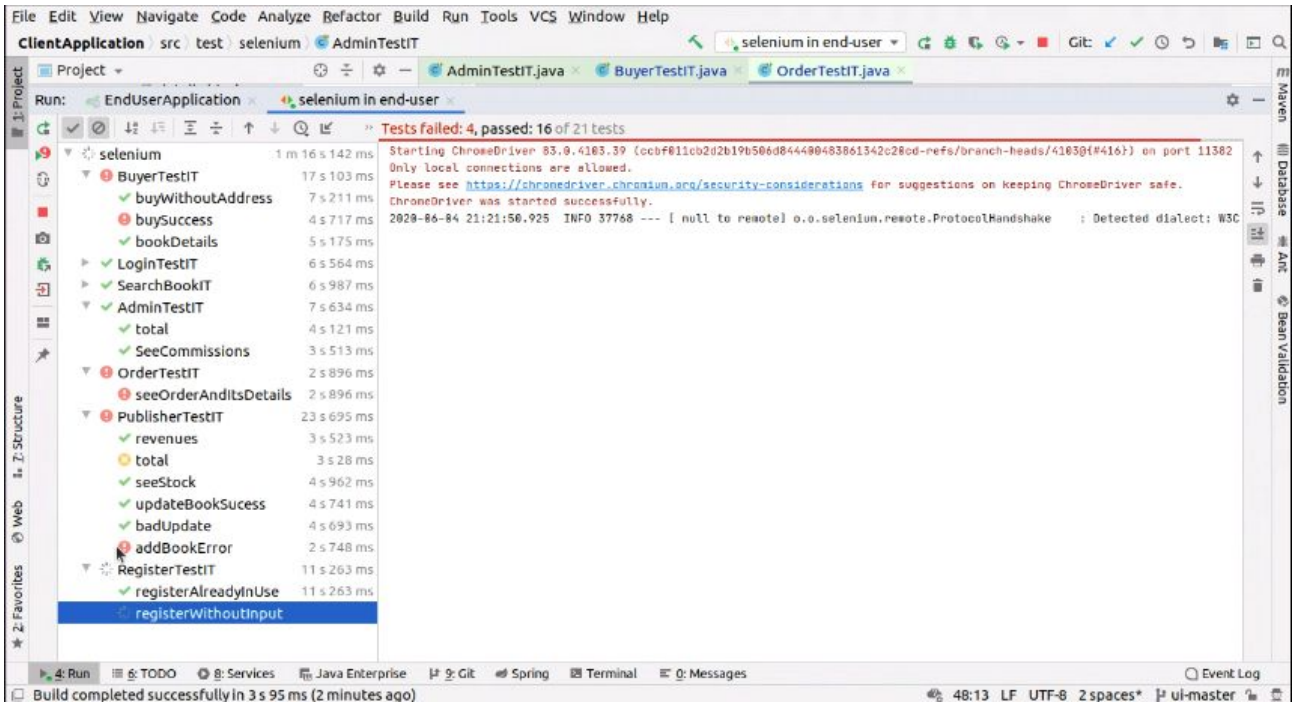
Selenium Flakiness Problem

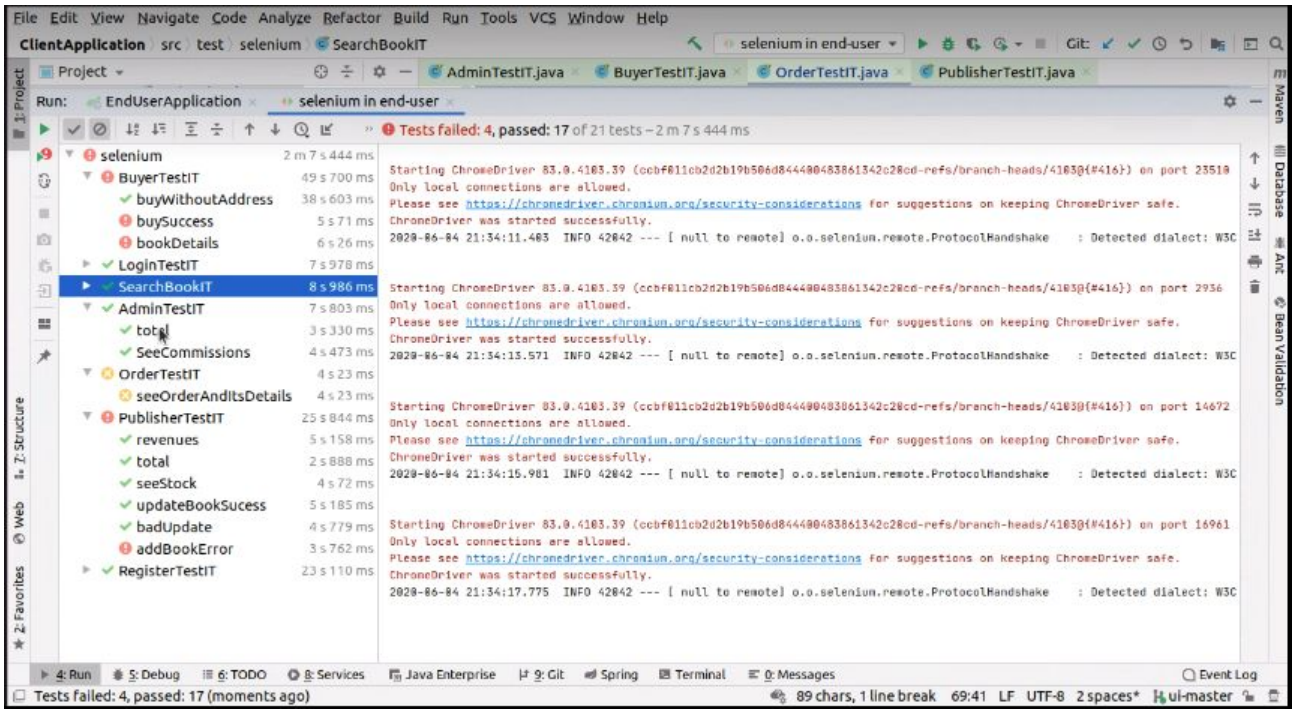
Selenium is a tool that has known and documented problems with tests that fail randomly when there hasn’t been any change to the code.[1] We have experienced these types of issues: sometimes the test will pass and other times it won’t.

We have documented these situations. The 3 tests below were run with the same code yet we had 3 different results. Therefore, we considered these tests too unstable to join the MVP.



[1] https://crossbrowsertesting.com/blog/selenium/problems-selenium-webdriver/ shows many examples of problems faced with selenium





We can pinpoint 2 main types of errors :

Unhandled Alert → For this error we waited for the alert and only accepted it after some time + we also tried to use Thread.sleep(). Both these solutions would sometimes work yet sometimes they wouldn't. Once again, very unstable

Element not interactable → In here we can see that the element is not found therefore can not be interacted yet when testing in the browser we could do so. Our solution was to wait for it to be clickable or being present yet it would always exceed our time.

Nonetheless we have kept stored in the UI-master branch all the other tests for all epics so that they can be consulted.

Branch: ui-master | BookStore / ClientApplication / src / test / selenium / | Create new file | Upload files | Find file | History

This branch is 36 commits ahead, 19 commits behind master. | Pull request | Compare

CarolinaRMarques fixed tests | Latest commit bb443ea 14 hours ago

..		
AdminTestIT.java	some tests added	18 hours ago
BuyerTestIT.java	new tests of EPICS	14 hours ago
LoginTestIT.java	some tests added	18 hours ago
OrderTestIT.java	fixed tests	14 hours ago
PublisherTestIT.java	new tests of EPICS	14 hours ago
RegisterTestIT.java	some tests added	18 hours ago
SearchBookIT.java	new tests of EPICS	14 hours ago

2. Unit tests

Unit tests should be written using a white box approach, which means that the inner workings of the implementation code that is being tested are fully known to the tester. Therefore, the tester should assume a developer perspective, even if they are not the person that actually wrote the code.

Policy for unit testing without mocking:
These straightforward unit tests should be mainly applied to Entities, DTO and Validators/Utils classes. The main goal is to cover each line of code in isolation and check if that line's behavior is working as expected. The only tool that should used is Junit 5.

It is very important that the names of the testing methods correctly describe the intent of each test. The name of the class that contains these tests should end with "Tests". They should be stored in a separate packages called "model", "dto" and "validator".

Policy for Unit testing with dependency isolation:
These tests should be applied to Service classes and Controllers. The main goal is to test their performance with dependency isolation. In other words, the behavior of their external dependencies (different services or repositories) can be controlled by Mockito and thus detached from the code that is meant to be tested independently. Therefore, these external components cannot impact the expected behavior of a unit of code anymore. MockMVC was used to simulate the behavior of an application server for the controllers. Mockito and Junit 5 should also be used.

It is very important that the names of the testing methods correctly describe the intent of each test. The name of the class that contains these tests should end with "Tests". They should be stored in a separate packages called "service" and "controller".

3. System and integration testing

Our integration tests should be written using a white box approach, which means that the inner workings of the implementation code that is being tested are fully known to the tester. Therefore, the tester should assume a developer perspective, even if they are not the person that actually wrote the

code. The tester will check if the contents of the JSON response that is being sent after a request to our API match their intent when writing the feature.

Policy for integration testing:
The aim of these tests is to verify the interactions between all the integrated components of the application. For the application pipeline to be working properly, the controllers should be able to interact with the available services and these should make calls to the repositories' methods, without any status failure caused by our end.

MockMVC should be used to simulate the behavior of an application server for the controllers.

A replica of the production database should be used during this stage, so that we can truly check the performance of the database with an EntityManager. New entries should be written purposely for these tests and they should be persisted and flushed to the DB. The test should confirm if these entries are part of the JSON response of the API request to the controller. Before writing the full integration tests that cover the whole system, we will be testing the repository separately in order to detect and fix early mistakes. This approach will make it easier to pinpoint the source of problems.

It is very important that the names of the testing methods correctly describe the intent of each test. The name of the class that contains these tests should end with "IT". They should be stored in a separate packages called "integration" and "repository".

For further API informal testing and documentation purposes, the developer should also set up a Postman collection for the team that contains their features' new endpoints and makes it easy to check the content of the responses. The UI developer can offer a black box perspective and check if the contents of the requests match their needs.