

SOEN390 - Software Engineering Team Design Project
Team 6 - Deliverable 5

Testing Plan and Report

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Table of Content

1. TESTING TOOL	3
1.1 Platform	3
1.1.1 Github	3
1.1.2 Sonarqube	3
1.2 Testing Module	3
2. APPROACH	3
2.1 Test Planning and Design	4
2.2 Unit Test	4
2.3 Integration Test	4
2.4 End-to-End (E2E)	4
3. METRICS	5
3.1 Reliability	5
3.2 Maintainability	6
3.3 Security	6
3.4 Coverage	7
3.5 Duplication	7
3.6 Size	8
3.7 Complexity	9
3.8 Issues	10
4. COVERAGE	11
5. ACCEPTANCE TEST	17
6. TEST RESULT	21

This test approach document describes the appropriate strategies, process, workflows and methodologies used to plan, organize, execute and manage testing of Condo Management System.

1. TESTING TOOL

As a part of the developing cycle, testing plays a key role in maintainability and reliability for existing software, including the Condo Management System. In 2 parts, backend and frontend, tests will be conducted under types of unit tests, integration test and system test.

1.1 Platform

2 platforms that we chose to implement for this project: Github platform and Sonarqube

1.1.1 Github

We implemented 2 workflows as GitHub actions for CI in our repository, one for dev branch and one for main branch. The CI GitHub action is responsible for building and deploying the frontend and backend, and for monitoring the status of the deployment on the server, not to mention the compatibility of the node_modules implemented throughout the project.

1.1.2 Sonarqube

We implemented Sonarqube to validate the code quality and maintainability. Not only it's a powerful static code analysis tool that automatically reviews codes for bugs, vulnerabilities, code smells and quality issues, but also it can indicate the latent issues early on, resulting in faster resolution and reducing risks in development.

1.2 Testing Module

Jest is a testing framework for unit and integration tests with the benefits of being simple, speedy and built-in features (mocks and snapshots). In the frontend, we implemented Jest with a configuration for Typescript, on the other hand, the backend is implemented with JavaScript. Jest, with its functions, can provide a quick test report with insightful data, telling the % coverage of statements, branches, functions and lines.

2. APPROACH

During the development process, the systematic approach is adopted to use Jest for testing. The process includes several important steps to ensure our tests' efficiency and the imminent resolution of issues may encounter:

2.1 Test Planning and Design

Supposedly, before any implementation, test cases and scenarios of each functional requirement, user story or acceptance criterion will be conveyed. All possible cases of functionality (positive, negative, edge, error) will have to be covered by test cases.

2.2 Unit Test

Unit testing evaluates individual components or "units" of software independently. It is a part of white box testing, an approach that examines the internal modules of the code. These units are the smallest testable pieces in the software. Unit testing is an essential component of software development since it ensures that each unit is executed correctly and detects any flaws early on. Following the TDD approach, each component, function or module will be put as top priority to write unit tests. After each implementation or code change, we execute the unit test to ensure the maintainability and quality of the updated codes. Notwithstanding, it results in high chances of catching regression earlier in the process and ensuring the new code still meets the expected behavior. A sample of a JEST unit testing on the Frontend side is shown below.

```
test("initially renders default request description", () => {  
  render(<Requests />);  
  const defaultDescription = screen.getByText(/I hope you're well/i);  
  expect(defaultDescription).toBeInTheDocument();  
});
```

Figure 1: Unit Testing Sample with JEST

2.3 Integration Test

Integration testing aims to evaluate the collective performance of various system components by examining their interactions rather than scrutinizing the entire system as a single entity. The focus is on verifying if these components communicate effectively. For instance, when component A transmits message X to component B, integration testing assesses whether their interactions result in the expected behaviors and functionalities. For instance, the landing page for the user profile is composed of several components. Testing these components separately would be unit testing, but testing them together and how they interact is integration testing.

Verification between frontend and backend components, API endpoints and data flow will be ensured by integration tests. We will be writing integration tests to ensure the quality of our code.

2.4 End-to-End (E2E)

Condo Management website's workflow from frontend UI and backend services will be tested by E2E with real user interaction, stimulated by Cypress UI. The reason we decided to go with Cypress is because it provides an intuitive UI which makes it easier to learn and use. Furthermore, Cypress provides a powerful debugging tool, developers can easily inspect the DOM element if a test assertion fails and find out what went wrong. Supposedly, E2E is less frequently run compared to unit and integration tests, only if there are some

major deployments such as pushing from dev to main. Broken user flows and critical bugs are more likely to be seen in this test as it provides confidence in overall functionality.

3.METRICS

With SonarQube it is easy to keep track of our quality metrics. The metrics are separated in two distinct sections. The first section is overview metrics, which combine other metrics to give an overall perspective of the code quality. As such, we have selected reliability, maintainability and issue metrics. The second section is singular metrics, which are security, test coverage, code duplication, code size, code complexity and issues.

3.1 Reliability

SonarQube assesses the reliability of code by identifying potential bugs, code smells, and other issues that could lead to unexpected behavior or system failures. By analyzing reliability metrics, such as the number of bugs detected and their severity, SonarQube helps ensure that the codebase is robust and dependable. Furthermore, the use of tests ensures that the functionalities work consistently according to the requirements. Finally, as part of our core development structure, each function also goes through manual testing in our dev environment. This acts as a final safety net to ensure that the code does what it is supposed to do consistently.



Figure 2: Reliability Report on Sprint 5

3.2 Maintainability

SonarQube assesses code maintainability based on readability, complexity, and adherence to coding standards and best practices. Improving maintainability measures such as code

duplication, cyclomatic complexity, and code coverage simplifies future maintenance, refactoring, and code review procedures.



Figure 3: Maintainability report for sprint 5

3.3 Security

SonarQube contains security-focused rules and tests that help uncover vulnerabilities, security hotspots, and possible security hazards in code. In addition, SonarQube reduces security risks and strengthens the application's overall security posture by assessing security metrics such as the number and severity of security vulnerabilities.



Figure 4: Security Report on Sprint 5

3.4 Coverage

SonarQube assesses code coverage by calculating the proportion of code covered by automated tests, such as unit tests, integration tests, and end-to-end tests. boosting code coverage measures assures that the codebase has been properly tested, lowering the possibility of undetected bugs and boosting overall product quality.

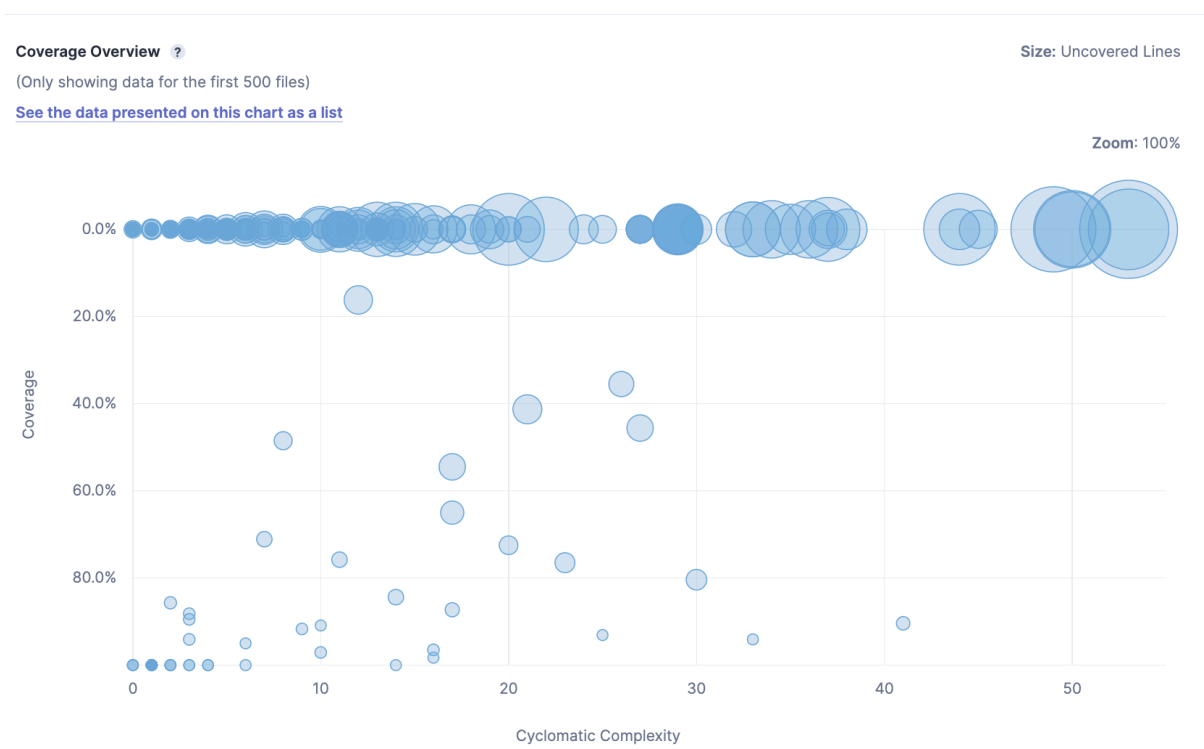


Figure 5: Coverage Report on Sprint 5

3.5 Duplication

Duplication is a metric that needs to be monitored correctly since multiple people work on the same project. For example, two developers work on two different features that have similarities. If there are no checks in place, the code can get bloated, and hard to read and maintain. Thus, SonarQube is used to help us reduce duplication by finding repeating code patterns or similar code parts throughout the source. Addressing code duplication improves maintainability, readability, and consistency, resulting in more efficient development and simpler issue fixes.

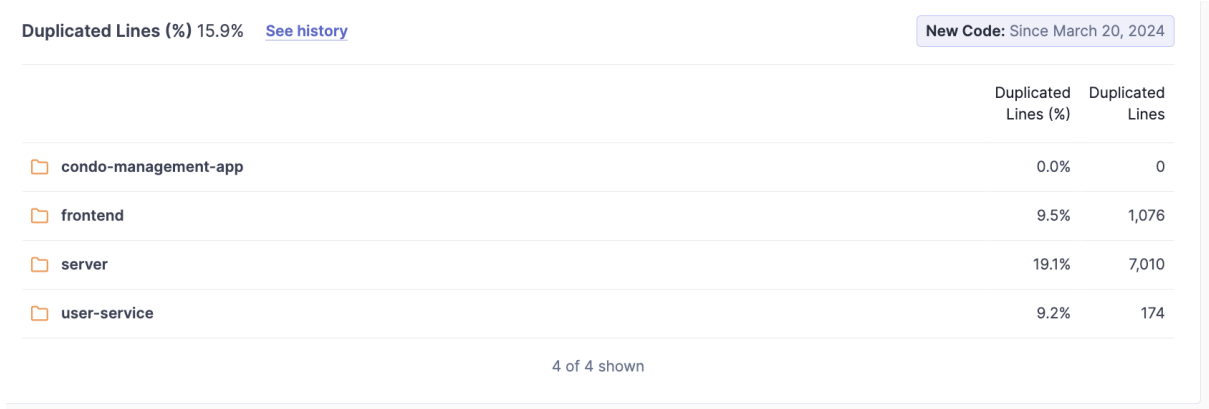


Figure 6: Duplication Report for sprint 5

3.6 Size

SonarQube gives information on the size of the codebase, including the number of files, lines of code, and code churn over time. Monitoring code size metrics allows us to track project growth, identify areas of code bloat or excessive complexity, and improve resource allocation and project planning.

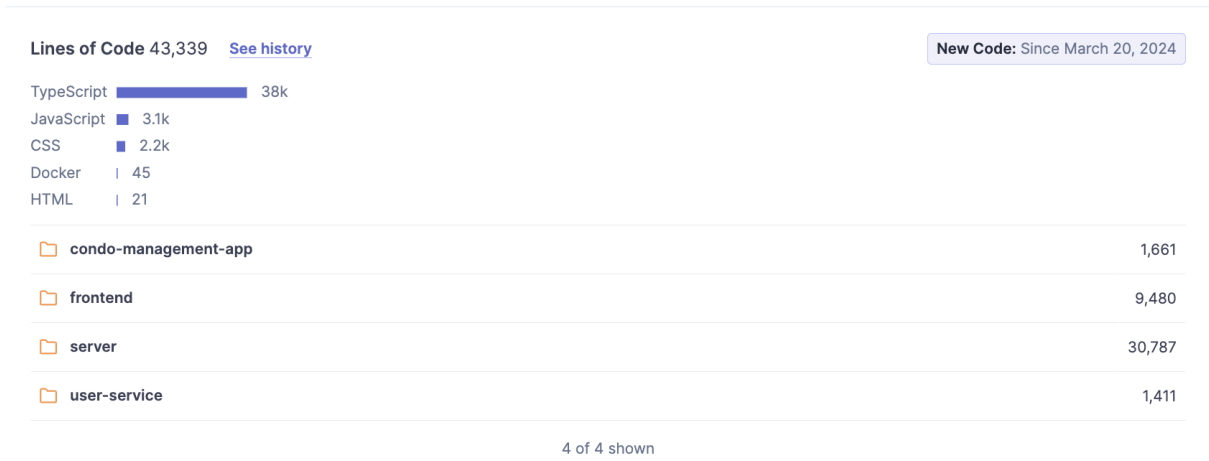


Figure 7: Line Of Code Report for Sprint 5

3.7 Complexity

SonarQube evaluates code complexity by measures such as cyclomatic complexity, nesting depth, and method length. Analyzing complexity metrics aids in identifying unnecessarily complicated code segments, potential failure spots, and places for rewriting or optimization to enhance code quality and maintenance.




Cyclomatic Complexity 5,083 See history		New Code: Since March 20, 2024
 condo-management-app		163
 frontend		868
 server		3,877
 user-service		175
4 of 4 shown		

Figure 8: Cyclomatic Complexity Report for sprint 5



Cognitive Complexity 962 See history		New Code: Since March 20, 2024
 condo-management-app		56
 frontend		304
 server		543
 user-service		59
4 of 4 shown		

Figure 9: Cognitive Complexity Report for sprint 5

3.8 Issues

SonarQube keeps track of issues found in the code, including but not limited to: code smells, potential bugs, bad practices, unnecessary hard coding etc...

This process is called linting and is a good tool to ensure consistent good practices across developers. As a consequence, issue tracking can increase the maintainability, readability, complexity and other software qualities. The number of issues should be kept as low as possible

Issues 655 See history		New Code: Since March 20, 2024
 condo-management-app		122
 frontend		211
 server		312
 user-service		10
4 of 4 shown		

Figure 10: Issue Report for sprint 5

4. COVERAGE

Software testing involves various metrics to assess the effectiveness of test cases in exercising the code. Four commonly used metrics are statement coverage, branch coverage, function coverage, and line coverage.

Statement coverage

measures the percentage of executable statements that have been executed at least once by the test cases. This metric provides insight into how well individual statements in the code have been exercised during testing.

Branch coverage

focuses on decision points in the code, such as if statements or loops. It assesses the percentage of decision branches that have been executed at least once, giving a more granular view of how well the code paths have been tested.

Function coverage

evaluates the percentage of functions or methods that have been executed by the test cases. This metric helps ensure that the different functional components of the software are adequately tested.

Line coverage

measures the percentage of lines of code that have been executed at least once. It provides a comprehensive overview of how well the entire codebase has been tested in terms of individual lines of code.

As asked in the requirements. We were able to pass 80% code coverage in sprint 1, 2, 3,4 and 5.

On the frontend side, the statement coverage overall was 91.99 %, the branch coverage was 87.64%, function coverage was 84.62% and lines were at 86.42% (as shown in the figure below. Therefore we succeeded at achieving over 80% for everything and the coverage is better than any other sprint. We had 59 test suites which is the same as the previous sprint since we removed some test suites and added new ones instead and we had 192 test cases(17 less test cases from sprint 4) which all passed without any failure. These numbers are significant compared to sprint 4.

On the backend side, the testing coverage did not change as no new features were added since everything was finished in the last sprint. the statement coverage overall was 97.48%, the branch coverage was 92.07%, function coverage was 92.69% and lines were at 94.64%. We were able to achieve over 80% coverage for all of these criterias. In total, there were 31 test suites compared to the 28 test suites from sprint 3 and 259 test suites this sprint compared to 251 testsuites last sprint. We have added a significant amount of tests compared to previous sprints to account for adding the financial system on our website. All of the test suites passed without exception. Compared to sprint 3, sprint 4's and sprint 5's statement coverage increased by around 2% which is due to the rigorous testing methods executed in this sprint for the additional functionalities. Our branch coverage has improved by 7%, while function and line coverage increased by 3% and 2 % respectively. That

being said, all our test metrics exceed the 80% mark despite the additional functionalities added in sprint 4.

One of JEST's advantages is that it can provide a report in .html format which creates a nice view for the user to see the coverage. A few snapshots of the report were taken below. This provides more details and insights to the person interested. For the future, we plan to maintain the overall code coverage of at least 80%. This will reduce the number of undetected bugs and will give us more confidence in our application. Code coverage enforcement can be done by configuring JEST to fail every time coverage drops below 80% which will prevent the PR from being merged.

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Frontend Reports:

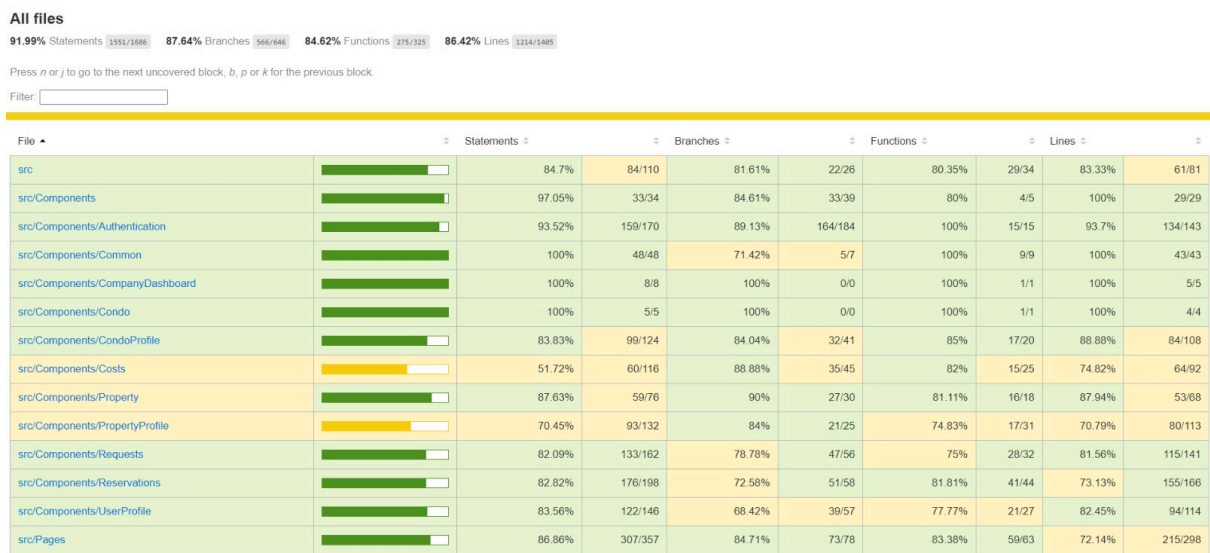


Figure 11: Main Page Report with JEST

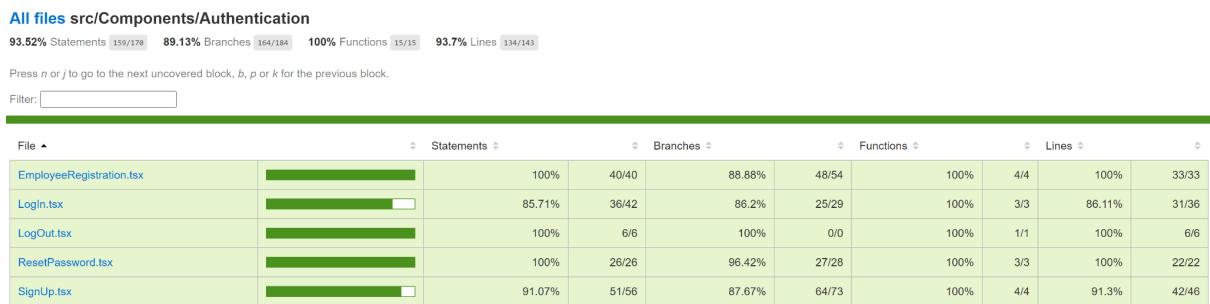


Figure 12: Detailed Statistics of the Authentication Folder and its Components

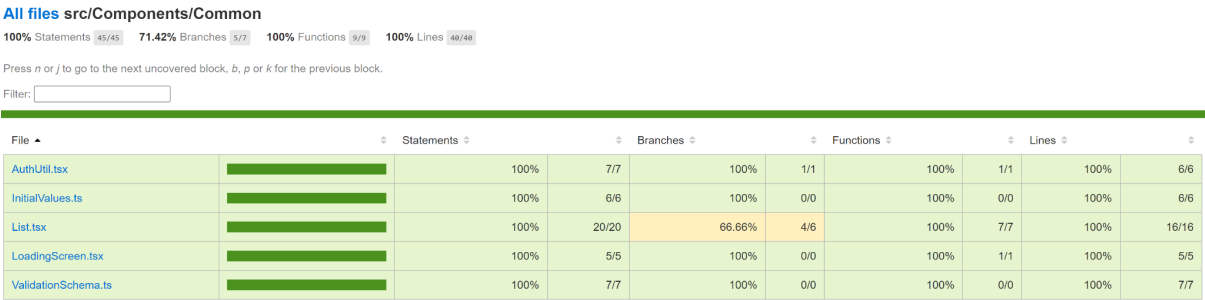


Figure 13: Detailed Statistics of the Common Folder with Reusable files

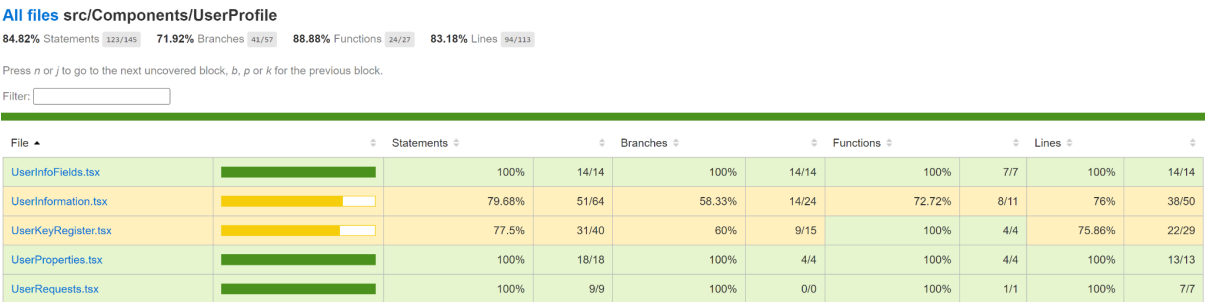


Figure 14: Detailed Statistics of the UserProfile

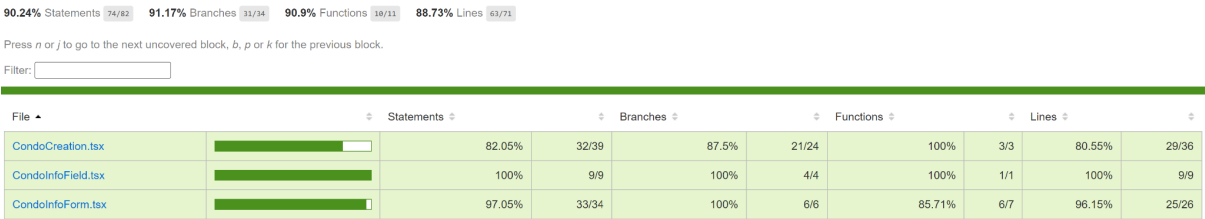


Figure 15: Detailed Statistics of the CondoProfile

The rest of the folders with no details have very few files, so it is already represented in the “All Files” section.

Backend Reports:

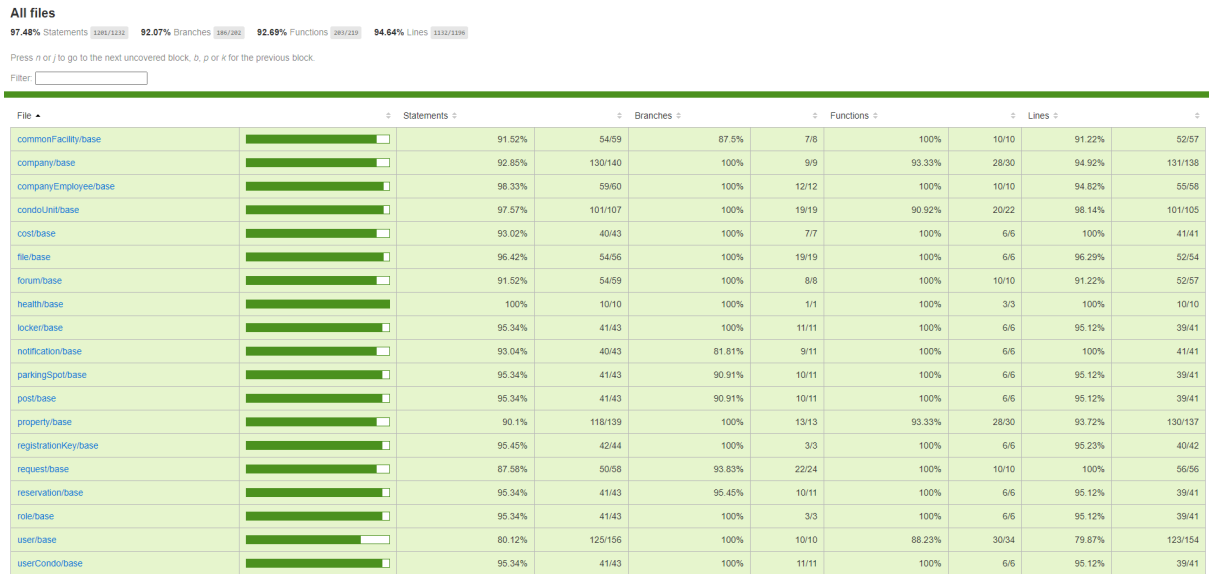


Figure 16: Main Page Report of the Backend with JEST

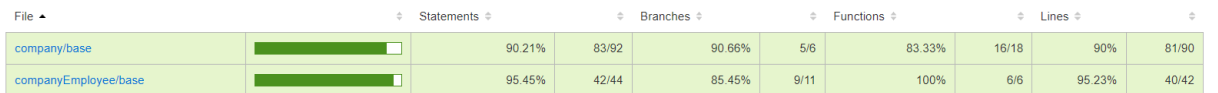


Figure 17: Detailed Statistics of company

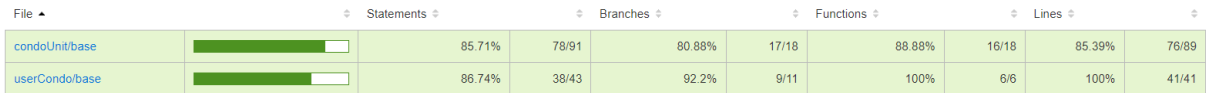


Figure 18: Detailed Statistics of condo

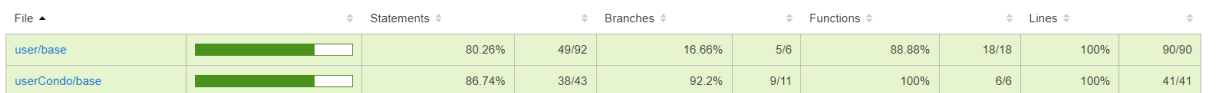


Figure 19: Detailed Statistics of User

The rest of the folders with no details only have 1 file, so it is already represented in the “All Files” section.

5.ACCEPTANCE TEST

Sprint 4 Acceptance Tests

Test ID	AT-1
Requirement	As a condo owner, I want to be able to reserve common facilities in a calendar-like interface.
Acceptance Criteria	User is logged into their account.
Test Case	Expected Results
TC-1 User clicks on "Common Facilities Calendar" from the dashboard page.	The user navigates to a calendar-like interface for common facilities.

Test ID	AT-2
Requirement Tested	As a condo management company, I want to be able to set up a common facility which requires reservations.
Acceptance Criteria	The user is logged into their account. The system provides a user interface to reserve a common facility.
Test Case:	Expected Results
TC-1 Company selects a date and time for a common facility that is available.	The reservation is successfully submitted, and the details are stored in the system.
TC-2 Company selects a date and time for a common facility that is unavailable.	The reservation is not successfully submitted and the user is notified to select a date and time from the dropdown for a valid submission.

Test ID	AT-3
Requirement Tested	As a rental user, I want to be able to see the availability of common facilities.
Acceptance Criteria	The user is logged into their account.
Test Case:	Expected Results

TC-1 User clicks on "Common Facilities Calendar" from the dashboard page.	The user navigates to a calendar-like interface for common facilities.
--	--

Test ID	AT-4
Requirement Tested	As a rental user, I want to be able to modify or cancel my existing reservation for a common facility.
Acceptance Criteria	Users can access the list of their reservations from the Common Facilities Calendar Page. The Reservations List page should display a list of all reservations related to the user's submissions.
Test Case:	Expected Results
TC-1 User deletes an existing reservation.	The system displays a confirmation prompt to confirm the deletion. Upon confirmation, the reservation entry is successfully removed from the system.
TC-2 User modifies an existing reservation with valid availability.	The system displays a confirmation prompt to confirm the modification. Upon confirmation, the reservation entry is successfully modified in the system.
TC-3 User deletes an existing reservation with invalid availability.	The modification is not successfully submitted and the user is notified to select a date and time from the dropdown for a valid submission.

Test ID	AT-5
Requirement Tested	As a condo management company, I want to be able to disable the availability of a common facility.
Acceptance Criteria	The user is logged into their account. The system provides a user interface to set the status of common facilities.
Test Case:	Expected Results
TC-1 Company assigns the status "Mark as	The status of the common facility is successfully updated in the system as closed,

Closed” to a common facility.	and permissions are configured to disallow users access to this facility for reservations.
TC-1 Company assigns the status “Mark as Open” to a common facility.	The status of the common facility is successfully updated in the system as open, and permissions are configured to allow users access to this facility for reservations.

Test ID	AT-6
Requirement Tested	As a condo management company, I want to be able to enter the condo fee per square foot, per parking spot for a condo unit.
Acceptance Criteria	The user is logged into their account. The system displays the user interface for setting condo fees for a condo unit.
Test Case:	Expected Results
TC-1 Company enters the fee per square foot.	The fee per square foot entry is successfully entered in the system.
TC-1 Company enters the fee per parking spot.	The fee per parking spot entry is successfully entered in the system.

Test ID	AT-7
Requirement Tested	As a condo management company, I want to be able to enter the cost for each operation.
Acceptance Criteria	User is logged into their account. The system provides a user interface to add cost for operations.
Test Case:	Expected Results
TC-1 Company selects an operation and assigns a cost to it.	The cost of the operation is successfully submitted and stored in the system.

Test ID	AT-8
Requirement Tested	As a condo owner, I want to be able to see the calculated condo fee for each unit.
Acceptance Criteria	The user is logged into their account. The

	system displays the condo owner's dashboard.
Test Case:	Expected Results
TC-1 Condo owner navigates to the "My Condos" section from the dashboard.	The system displays the list of condos under the condo owner's ownership.
TC-2 Condo owner selects a specific condo from the condos list to view its profile.	The system navigates to and displays the selected condo profile and displays its details, such as size, occupant name, and condo fee.

Test ID	AT-9
Requirement Tested	As a condo management company, I want to be able to see a record of the operational budget, which includes the total condo fees collected from condo owners.
Acceptance Criteria	The user is logged into their account. The system displays the company's dashboard dashboard.
Test Case:	Expected Results
TC-1 Company navigates to the "Operational Budget Report" section from the dashboard.	The system displays the report for the condo fees collected from condo owners.

Test ID	AT-10
Requirement Tested	As a condo management company, I want to be able to see an annual report.
Acceptance Criteria	The user is logged into their account. The system displays the company's dashboard.
Test Case:	Expected Results
TC-1 Company navigates to the "Annual Report" section from the dashboard.	The system displays the annual report, including details of the revenue, expenses and profits of the company.

6. TEST RESULT

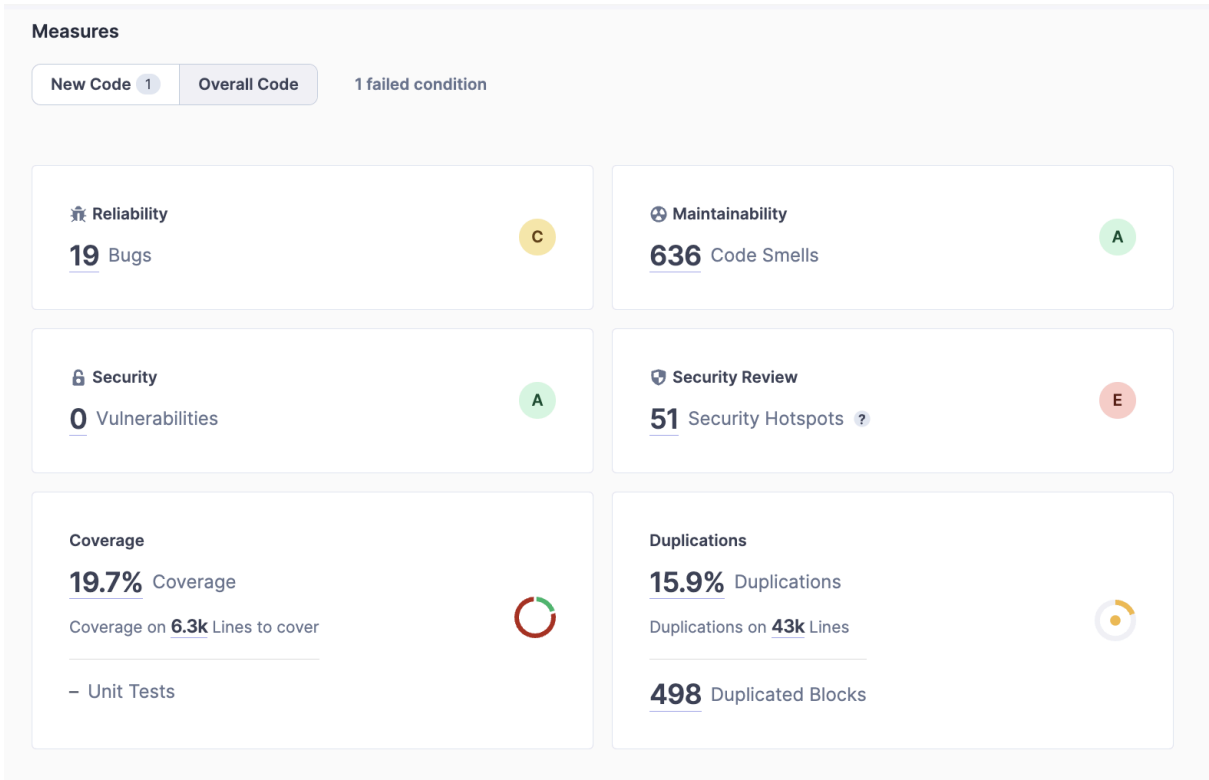


Figure 20: SonarQube Analytics Result for overall Code