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Adv.DevOps Experiment 8

Aim: Create a Jenkins CICD Pipeline with SonarQube / GitLab Integration to perform a static analysis of the code to detect bugs, code smells, and security vulnerabilities on a sample Web / Java / Python application.

Theory:

What is SAST?

Static application security testing (SAST), or static analysis, is a testing methodology that analyzes source code to find security vulnerabilities that make your organization's applications susceptible to attack. SAST scans an application before the code is compiled. It's also known as white box testing.

What problems does SAST solve?

SAST takes place very early in the software development life cycle (SDLC) as it does not require a working application and can take place without code being executed. It helps developers identify vulnerabilities in the initial stages of development and quickly resolve issues without breaking builds or passing on vulnerabilities to the final release of the application.

SAST tools give developers real-time feedback as they code, helping them fix issues before they pass the code to the next phase of the SDLC. This prevents security-related issues from being considered an afterthought. SAST tools also provide graphical representations of the issues found, from source to sink. These help you navigate the code easier. Some tools point out the exact location of vulnerabilities and highlight the risky code. Tools can also provide in-depth guidance on how to fix issues and the best place in the code to fix them, without requiring deep security domain expertise.

It's important to note that SAST tools must be run on the application on a regular basis, such as during daily/monthly builds, every time code is checked in, or during a code release.

Why is SAST important?

Developers dramatically outnumber security staff. It can be challenging for an organization to find the resources to perform code reviews on even a fraction of its applications. A key strength of SAST tools is the ability to analyze 100% of the codebase. Additionally, they are much faster than manual secure code reviews performed by humans. These tools can scan millions of lines of code in a matter of minutes. SAST tools automatically identify critical vulnerabilities—such as buffer overflows, SQL injection, cross-site scripting, and others—with high confidence.

What is a CI/CD Pipeline?

CI/CD pipeline refers to the Continuous Integration/Continuous Delivery pipeline. Before we dive deep into this segment, let's first understand what is meant by the term ‘pipeline’?

A pipeline is a concept that introduces a series of events or tasks that are connected in a sequence to make quick software releases. For example, there is a task, that task has got five different stages, and each stage has got some steps. All the steps in phase one have to be completed, to mark the latter stage to be complete.

Now, consider the CI/CD pipeline as the backbone of the DevOps approach. This Pipeline is responsible for building codes, running tests, and deploying new software versions. The Pipeline executes the job in a defined manner by first coding it and then structuring it inside several blocks that may include several steps or tasks.

What is SonarQube?

SonarQube is an open-source platform developed by SonarSource for continuous inspection of code quality. Sonar does static code analysis, which provides a detailed report of bugs, code smells, vulnerabilities, code duplications.

It supports 25+ major programming languages through built-in rulesets and can also be extended with various plugins.

Benefits of SonarQube

- **Sustainability -** Reduces complexity, possible vulnerabilities, and code duplications, optimising the life of applications.
- **Increase productivity -** Reduces the scale, cost of maintenance, and risk of the application; as such, it removes the need to spend more time changing the code
- **Quality code -** Code quality control is an inseparable part of the process of software development.
- **Detect Errors -** Detects errors in the code and alerts developers to fix them automatically before submitting them for output.
- **Increase consistency -** Determines where the code criteria are breached and enhances the quality
- **Business scaling -** No restriction on the number of projects to be evaluated
- **Enhance developer skills -** Regular feedback on quality problems helps developers to improve their coding skills

Integrating Jenkins with SonarQube:

Prerequisites:

- Jenkins installed
- Docker Installed (for SonarQube)
- SonarQube Docker Image

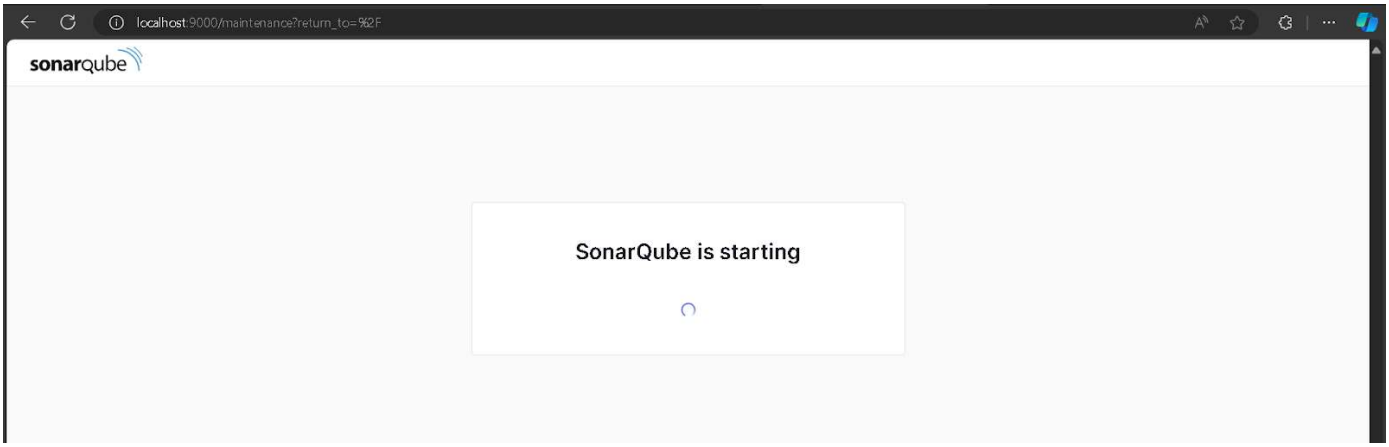
Steps to create a Jenkins CI/CD Pipeline and use SonarQube to perform SAST

1. Open up Jenkins Dashboard on localhost, port 8080 or whichever port it is at for you.

2. Run SonarQube in a Docker container using this command -

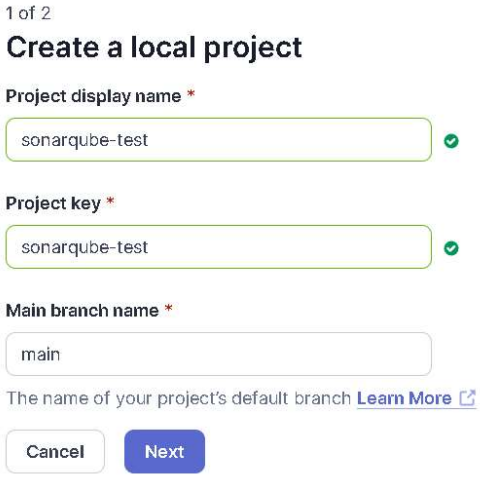
```
PS C:\Users\devpg> docker run -d --name sonarqube -e SONAR_ES_BOOTSTRAP_CHECKS_DISABLE=true -p 9000:9000 sonarqube:latest
Unable to find image 'sonarqube:latest' locally
latest: Pulling from library/sonarqube
762bedf4b1b7: Pull complete
95f9bd9906fa: Pull complete
a32d681e6b99: Pull complete
aabdd0a18314: Pull complete
5161e45ecd8d: Pull complete
aeb0020dfa06: Pull complete
01548d361aea: Pull complete
4f4fb700ef54: Pull complete
Digest: sha256:bb444c58c1e04d8a147a3bb12af941c57e0100a5b21d10e599384d59bed36c86
Status: Downloaded newer image for sonarqube:latest
60de6878d0614254500f608f43d81a3430585dc282e74225fe2a8fa237ee9d76
PS C:\Users\devpg>
```

3. Once the container is up and running, you can check the status of SonarQube at localhost port 9000.



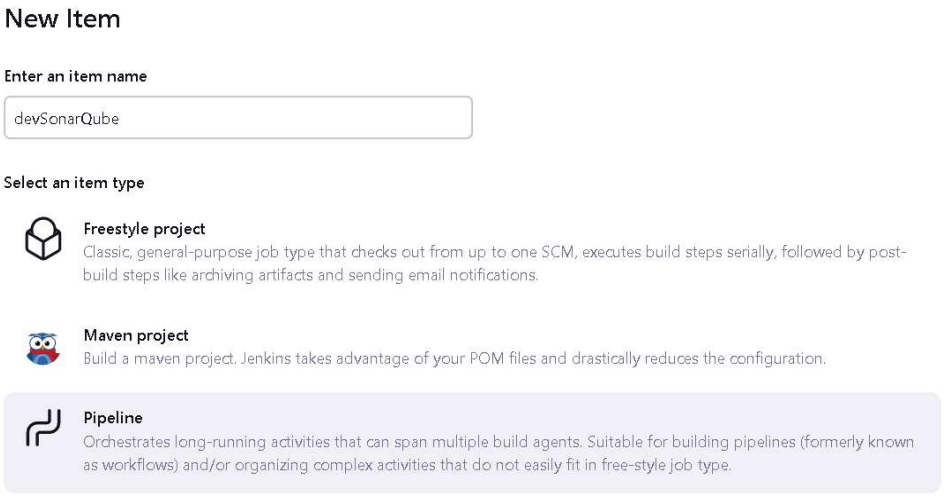
4. Login to SonarQube using username *admin* and password *admin*.

5. Create a manual project in SonarQube with the name **sonarqube-test**



Setup the project and come back to Jenkins Dashboard.

6. Create a New Item in Jenkins, choose **Pipeline**.



7. Under Pipeline Script, enter the following -

```
node {
  stage('Cloning the GitHub Repo') {
    git 'https://github.com/shazforiot/GOL.git'
  }
  stage('SonarQube analysis') {
    withSonarQubeEnv('sonarqube') {
      sh "<PATH_TO_SONARQUBE_FOLDER>//bin//sonar-scanner \
      -D sonar.login=<SonarQube_USERNAME> \
      -D sonar.password=<SonarQube_PASSWORD> \
      -D sonar.projectKey=<Project_KEY> \
      -D sonar.exclusions=vendor/**,resources/**,**/*.java \
      -D sonar.host.url=http://127.0.0.1:9000/"
    }
  }
}
```

Pipeline

Definition

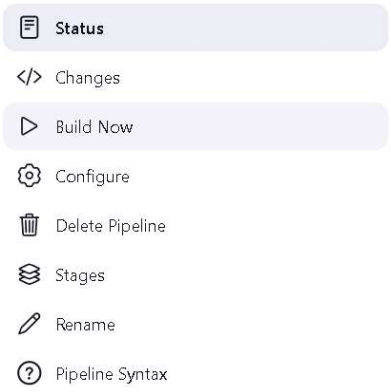
Pipeline script

Script ?

```
node {
    stage('Cloning the GitHub Repo') {
        git 'https://github.com/shazforiot/GOL.git'
    }
    stage('SonarQube Analysis') {
        withSonarQubeEnv('sonarqube') {
            bat """
            C:/ProgramData/Jenkins/.jenkins/tools/hudson.plugins.sonar.SonarRunnerInstallation/sonarqube/bin/sonar-scanner.bat ^
            -Dsonar.login=admin ^
            -Dsonar.password=helloworld ^
            -Dsonar.projectKey=sonarqube-test ^
            -Dsonar.exclusions=vendor/**,resources/**,**/*.java ^
            -Dsonar.host.url=http://127.0.0.1:9000/
            """
        }
    }
}
```

It is a java sample project which has a lot of repetitions and issues that will be detected by SonarQube.

8. Run The Build.



9. Check the console output once the build is complete.

Console Output

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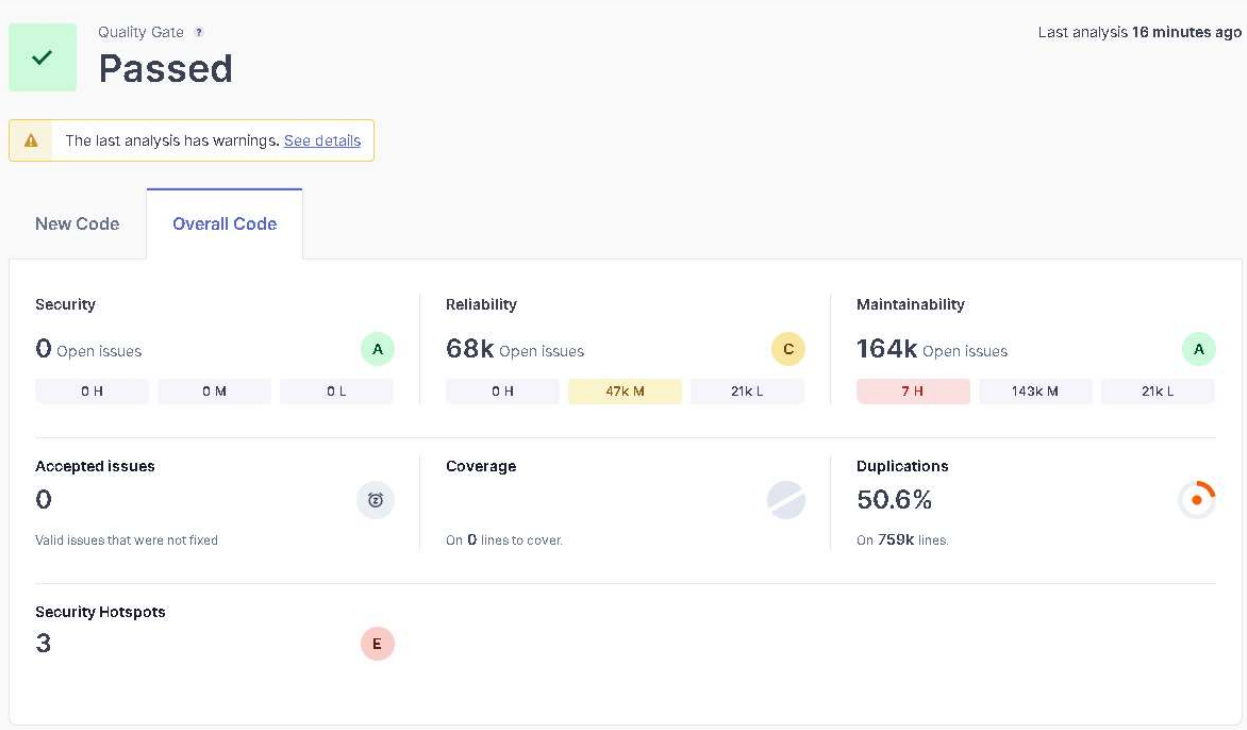
```
Started by user Dev Gaonkar
[Pipeline] Start of Pipeline
[Pipeline] node
Running on Jenkins in C:\ProgramData\Jenkins\.jenkins\workspace\devSonarQube
[Pipeline] {
[Pipeline] stage
[Pipeline] { (Cloning the GitHub Repo)
[Pipeline] git
The recommended git tool is: NONE
No credentials specified
 > C:\Program Files\Git\bin\git.exe rev-parse --resolve-git-dir C:\ProgramData\Jenkins\.jenkins\workspace\devSonarQube\.git # timeout=10
Fetching changes from the remote Git repository
 > C:\Program Files\Git\bin\git.exe config remote.origin.url https://github.com/shazforiot/GOL.git # timeout=10
Fetching upstream changes from https://github.com/shazforiot/GOL.git
 > C:\Program Files\Git\bin\git.exe --version # timeout=10
 > git --version # 'git version 2.42.0.windows.2'
 > C:\Program Files\Git\bin\git.exe fetch --tags --force --progress -- https://github.com/shazforiot/GOL.git +refs/heads/*:refs/remotes/origin/* #
timeout=10
 > C:\Program Files\Git\bin\git.exe rev-parse "refs/remotes/origin/master^{commit}" # timeout=10
Checking out Revision ba799ba7e1b576f04a4612322b0412c5e6e1e5e4 (refs/remotes/origin/master)
 > C:\Program Files\Git\bin\git.exe config core.sparsecheckout # timeout=10
 > C:\Program Files\Git\bin\git.exe checkout -f ba799ba7e1b576f04a4612322b0412c5e6e1e5e4 # timeout=10
 > C:\Program Files\Git\bin\git.exe branch -a -v --no-abbrev # timeout=10
 > C:\Program Files\Git\bin\git.exe branch -D master # timeout=10
 > C:\Program Files\Git\bin\git.exe checkout -b master ba799ba7e1b576f04a4612322b0412c5e6e1e5e4 # timeout=10
Commit message: "Update Jenkinsfile"
```

```
21:33:24.250 WARN  Too many duplication references on file gameoflife-web/tools/jmeter/docs/api/org/apache/jmeter/gui/util/TextAreaCellRenderer.html
for block at line 75. Keep only the first 100 references.
21:33:24.253 INFO  CPD Executor CPD calculation finished (done) | time=109702ms
21:33:24.381 INFO  SCM revision ID 'ba799ba7e1b576f04a4612322b0412c5e6e1e5e4'
21:34:52.072 INFO  Analysis report generated in 3326ms, dir size=127.2 MB
21:35:00.718 INFO  Analysis report compressed in 8633ms, zip size=29.6 MB
21:35:02.183 INFO  Analysis report uploaded in 1462ms
21:35:02.188 INFO  ANALYSIS SUCCESSFUL, you can find the results at: http://127.0.0.1:9000/dashboard?id=sonarqube-test
21:35:02.188 INFO  Note that you will be able to access the updated dashboard once the server has processed the submitted analysis report
21:35:02.188 INFO  More about the report processing at http://127.0.0.1:9000/api/ce/task?id=4fcac741-ad4f-4465-99b6-bd81a49a94cd
21:35:11.422 INFO  Analysis total time: 8:38.464 s
21:35:11.434 INFO  SonarScanner Engine completed successfully
21:35:12.040 INFO  EXECUTION SUCCESS
21:35:12.079 INFO  Total time: 8:45.529s
[Pipeline] }
[Pipeline] // withSonarQubeEnv
[Pipeline] }
[Pipeline] // stage
[Pipeline] }
[Pipeline] // node
[Pipeline] End of Pipeline
Finished: SUCCESS
```

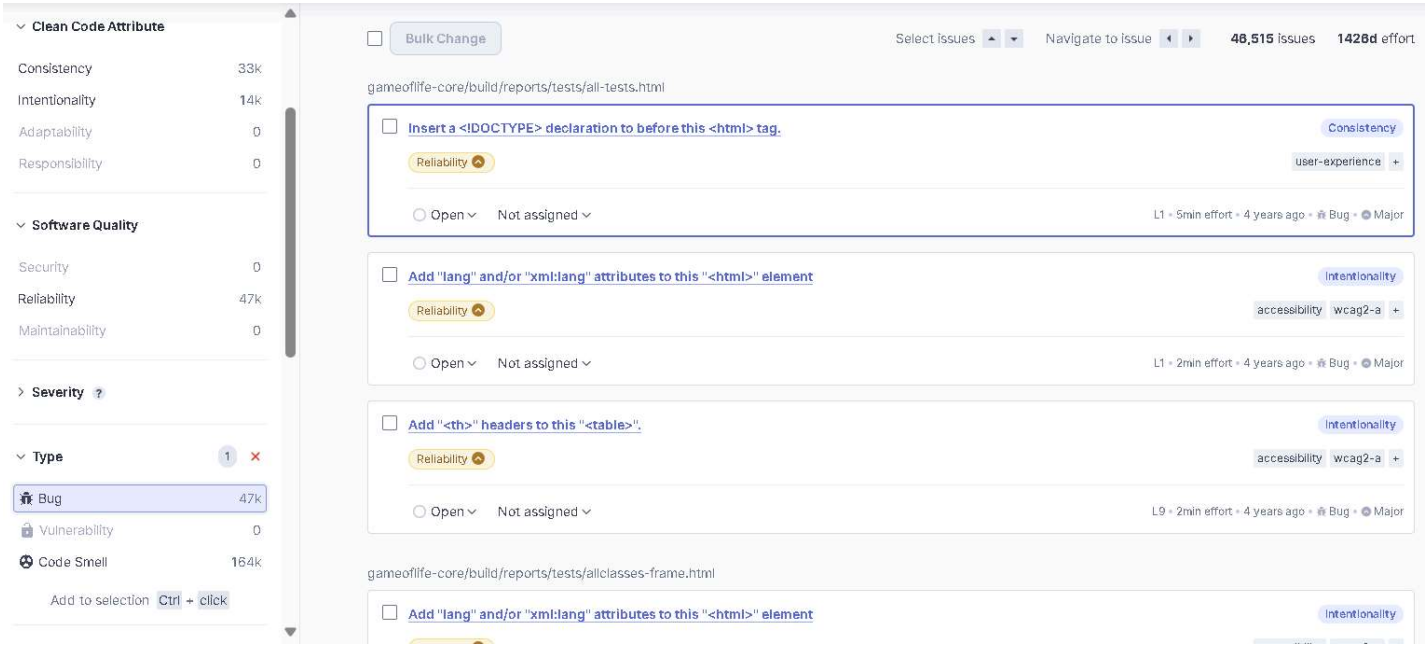
10. After that, check the project in SonarQube.



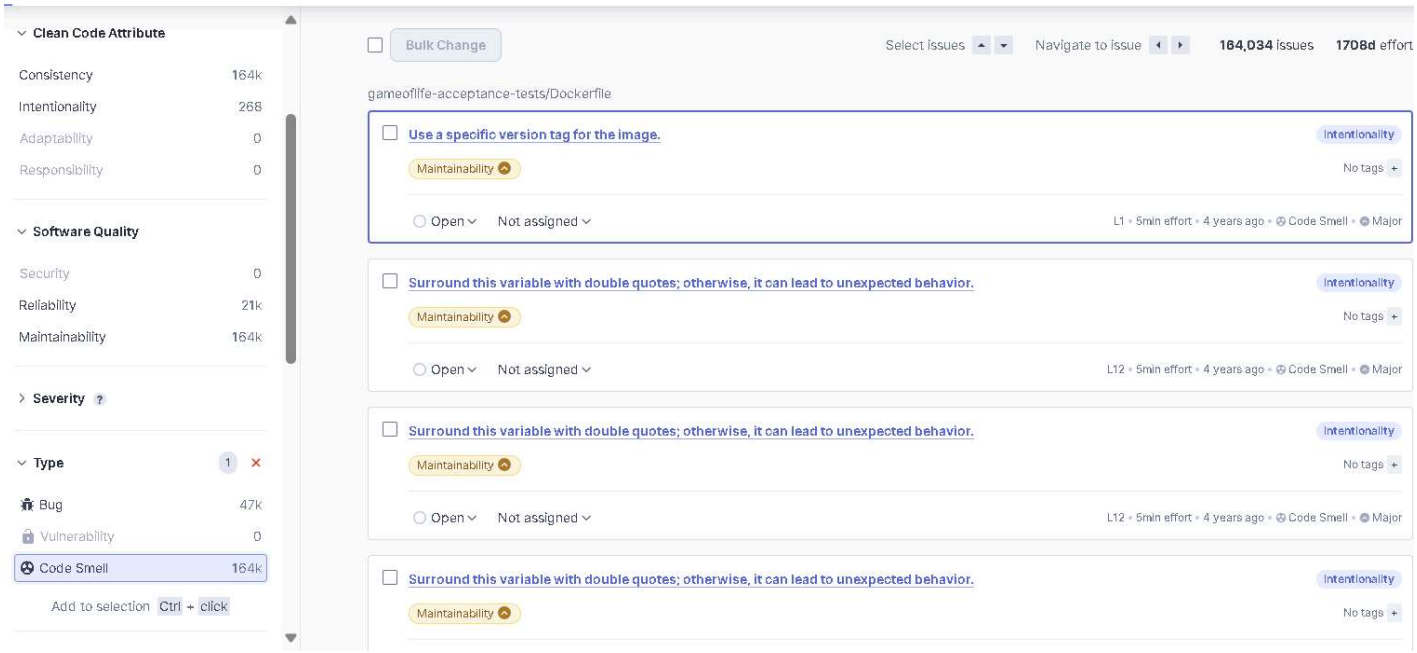
Under different tabs, check all different issues with the code.

11. Code Problems -

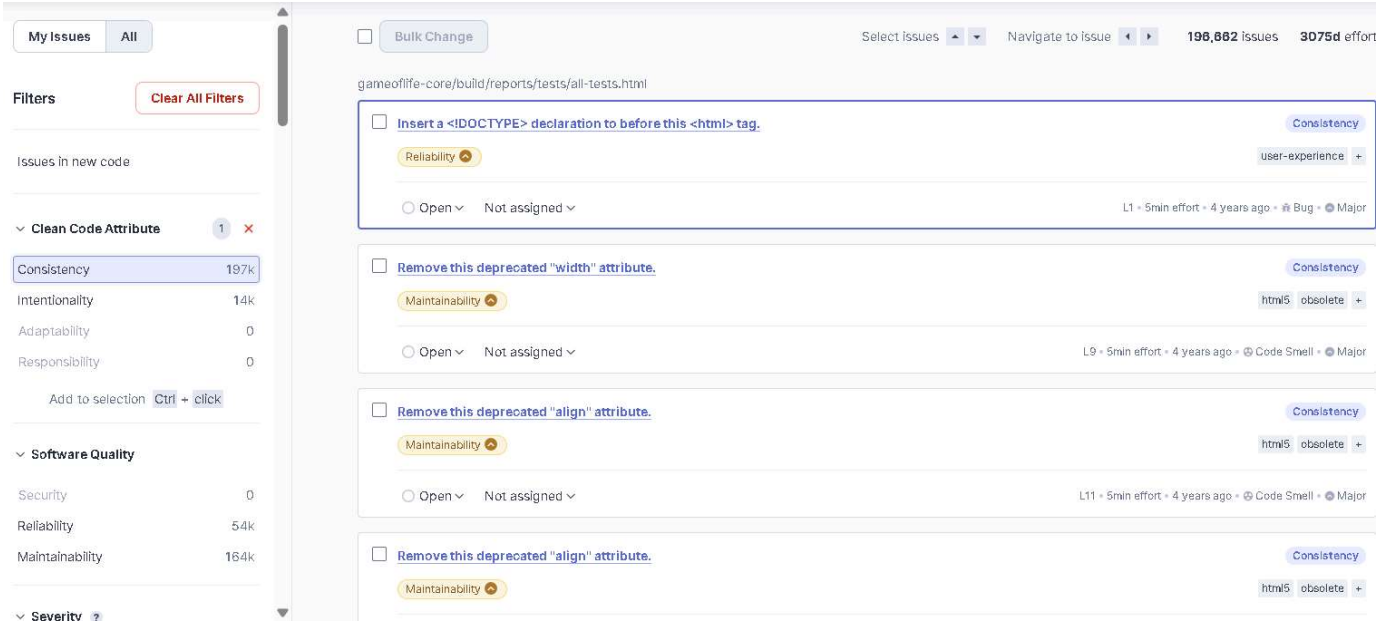
Bugs:



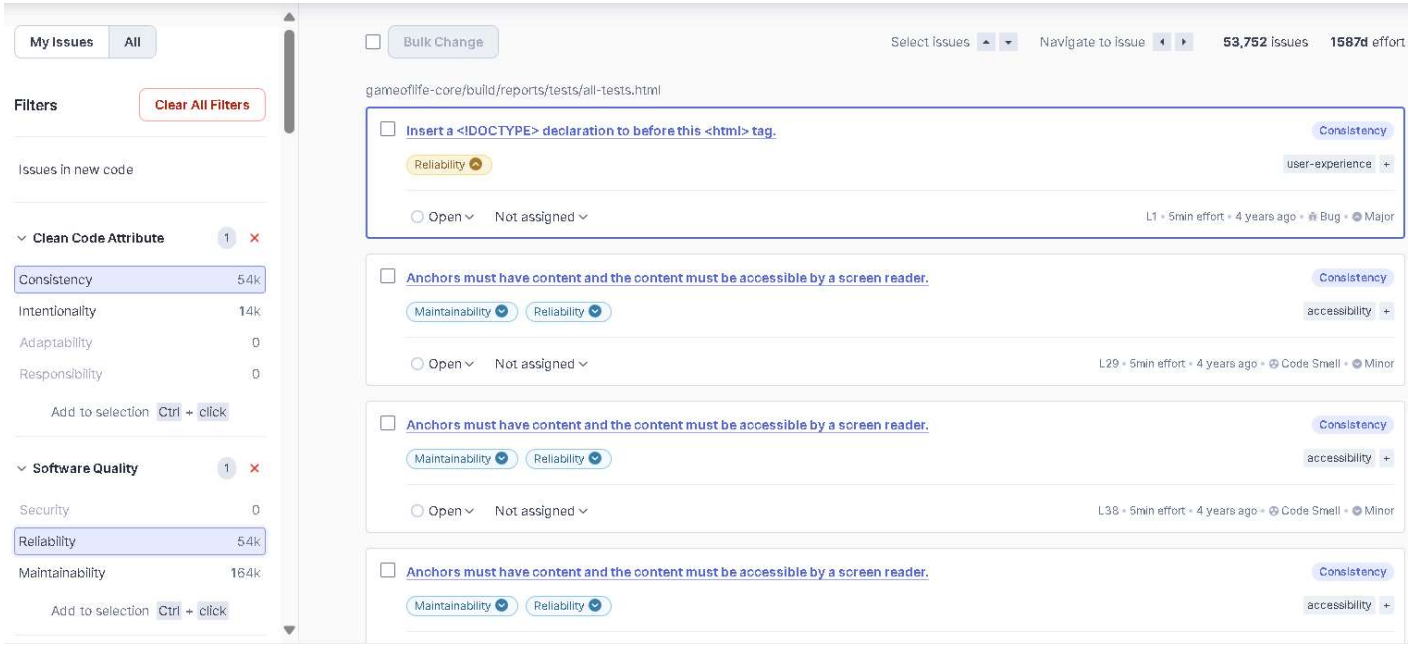
Code Smells:



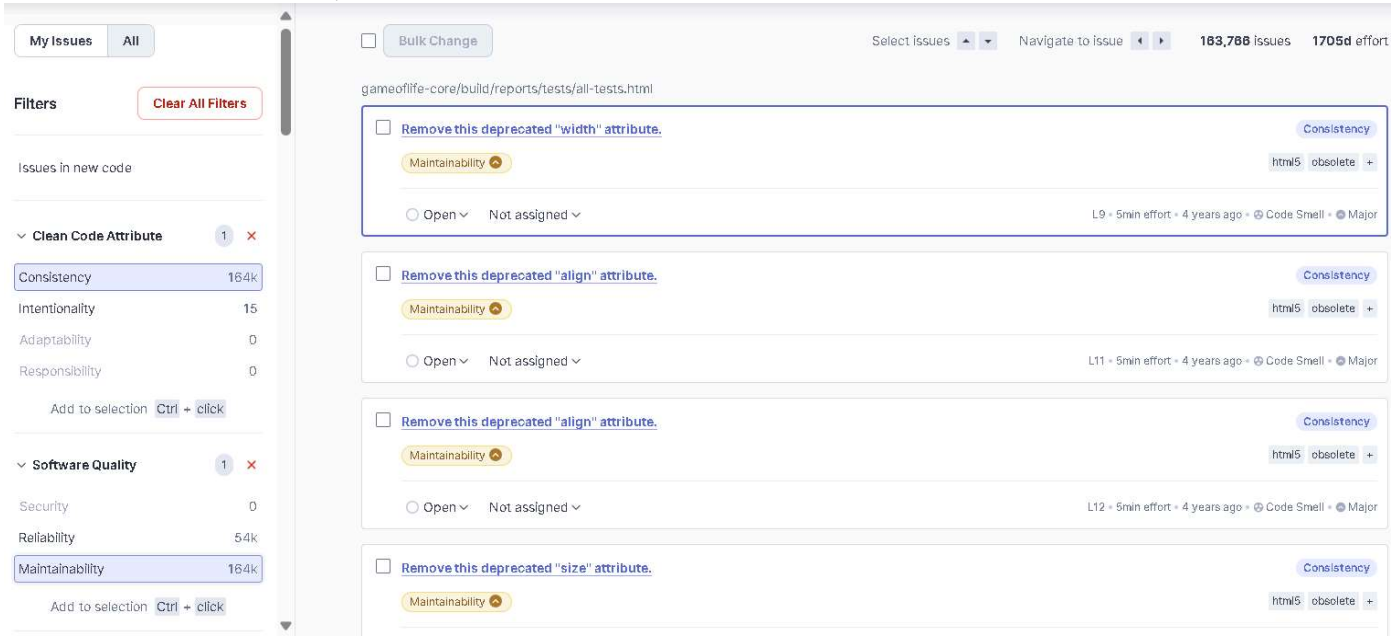
Consistency Issues:



Reliability Issues:



Maintainability Issues:



In this way, we have created a CI/CD Pipeline with Jenkins and integrated it with SonarQube to find issues in the code like bugs, code smells, duplicates, cyclomatic complexities, etc.

Conclusion:

In conclusion, integrating Jenkins with SonarQube through a CI/CD pipeline enhances code quality by automating static code analysis. By setting up SonarQube in a Docker container and configuring Jenkins to run SonarQube scans, we can efficiently detect and address bugs, code smells, and security vulnerabilities early in the development cycle. This approach ensures comprehensive code inspections and provides actionable feedback, leading to more secure and maintainable code. Ultimately, this integration streamlines the development process, improves software quality, and supports continuous improvement in coding practices.