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Experiment 7

Aim: To understand Static Analysis SAST process and learn to integrate Jenkins SAST to SonarQube/GitLab.

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. Thus, integrating static analysis into the SDLC can yield dramatic results in the overall quality of the code developed.

What are the key steps to run SAST effectively?

There are six simple steps needed to perform SAST efficiently in organizations that have a very large number of applications built with different languages, frameworks, and platforms.

1. **Finalize the tool.** Select a static analysis tool that can perform code reviews of applications written in the programming languages you use. The tool should also be able to comprehend the underlying framework used by your software.

2. **Create the scanning infrastructure, and deploy the tool.** This step involves handling the licensing requirements, setting up access control and authorization, and procuring the resources required (e.g., servers and databases) to deploy the tool.

3. **Customize the tool.** Fine-tune the tool to suit the needs of the organization. For example, you might configure it to reduce false positives or find additional security vulnerabilities by writing new rules or updating existing ones. Integrate the tool into the build environment, create dashboards for tracking scan results, and build custom reports.

4. **Prioritize and onboard applications.** Once the tool is ready, onboard your applications. If you have a large number of applications, prioritize the high-risk applications to scan first. Eventually, all your applications should be onboarded and scanned regularly, with application scans synced with release cycles, daily or monthly builds, or code check-ins.

5. **Analyze scan results.** This step involves triaging the results of the scan to remove false positives. Once the set of issues is finalized, they should be tracked and provided to the deployment teams for proper and timely remediation.

6. **Provide governance and training.** Proper governance ensures that your development teams are employing the scanning tools properly. The software security touchpoints should be present within the SDLC. SAST should be incorporated as part of your application development and deployment process.

Integrating Jenkins with SonarQube:

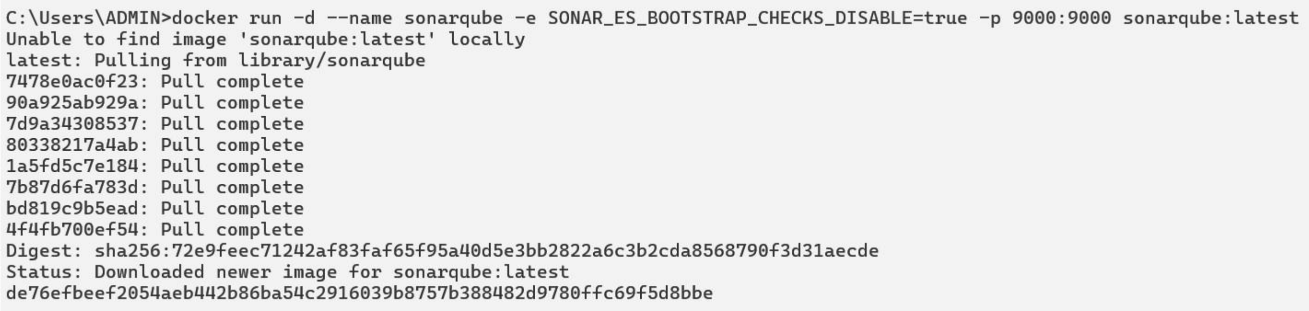
Prerequisites:

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

Steps to integrate Jenkins with SonarQube

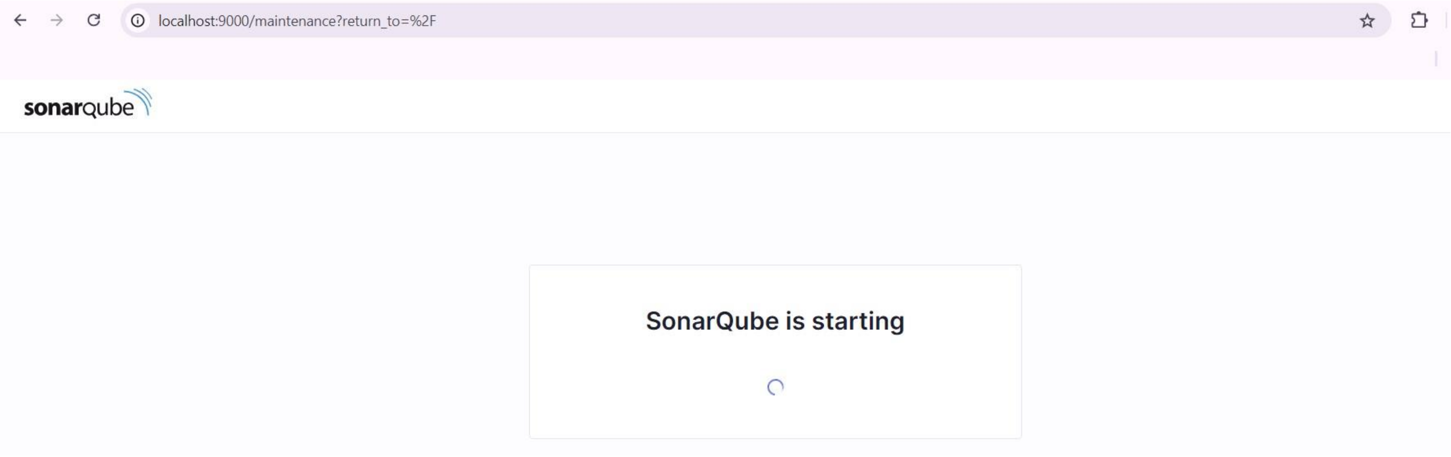
1. Open up Jenkins Dashboard on localhost, port 8080 or whichever port it is at for you.

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



```
C:\Users\ADMIN>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
7478e0ac0f23: Pull complete
90a925ab929a: Pull complete
7d9a34308537: Pull complete
80338217a4ab: Pull complete
1a5fd5c7e184: Pull complete
7b87d6fa783d: Pull complete
bd819c9b5ead: Pull complete
4f4fb700ef54: Pull complete
Digest: sha256:72e9feec71242af83faf65f95a40d5e3bb2822a6c3b2cda8568790f3d31aecde
Status: Downloaded newer image for sonarqube:latest
de76efbeef2054aeb442b86ba54c2916039b8757b388482d9780ffc69f5d8bbe
```

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

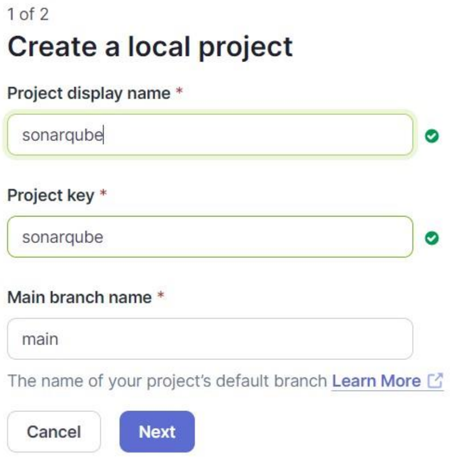


localhost:9000/maintenance?return_to=%2F

SonarQube is starting

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

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



1 of 2

Create a local project

Project display name *: sonarqube

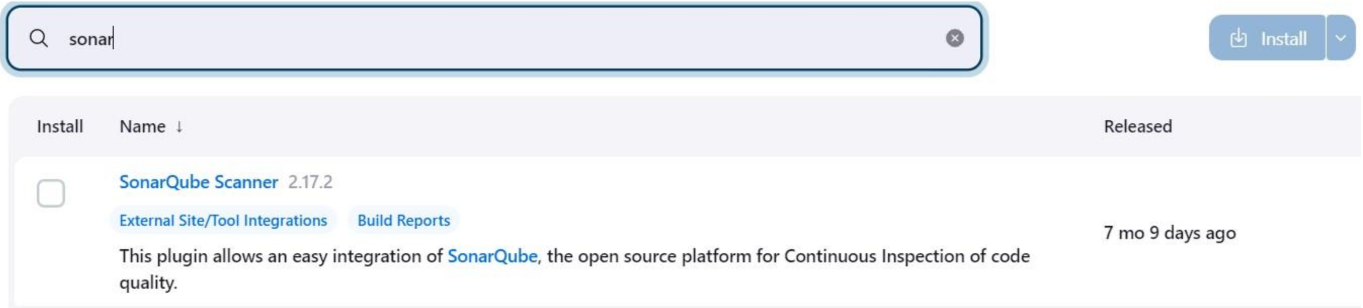
Project key *: sonarqube

Main branch name *: main

The name of your project's default branch Learn More

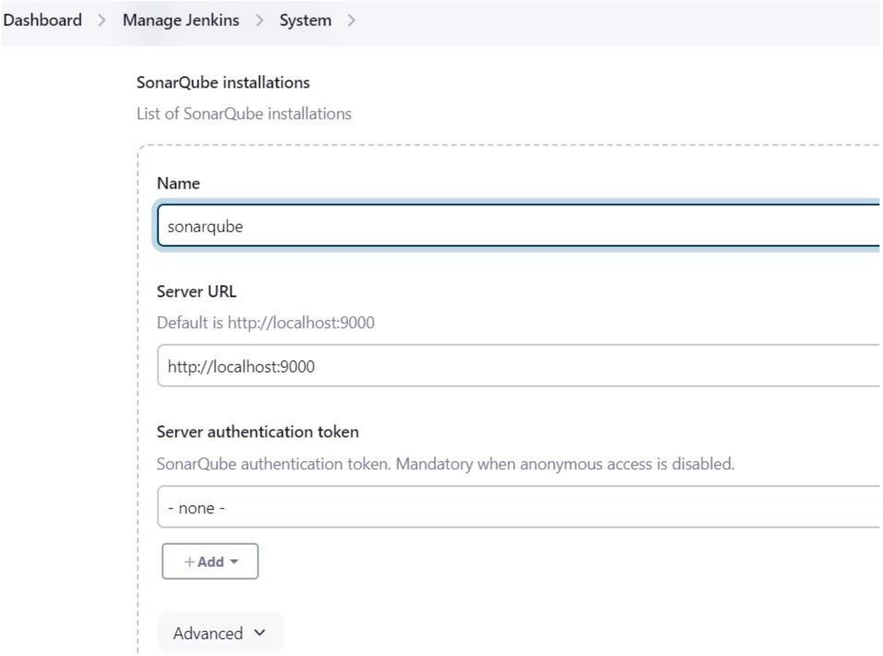
Setup the project and come back to Jenkins Dashboard.

6. Go to Manage Jenkins and search for SonarQube Scanner for Jenkins and install it.


sonar

Install	Name ↓	Released
□	SonarQube Scanner 2.17.2 External Site/Tool Integrations Build Reports This plugin allows an easy integration of SonarQube, the open source platform for Continuous Inspection of code quality.	7 mo 9 days ago

7. Under Jenkins ‘Configure System’, look for SonarQube Servers and enter the details. Enter the Server Authentication token if needed.


Dashboard > Manage Jenkins > System >

SonarQube installations

List of SonarQube installations

Name: sonarqube

Server URL

Default is http://localhost:9000

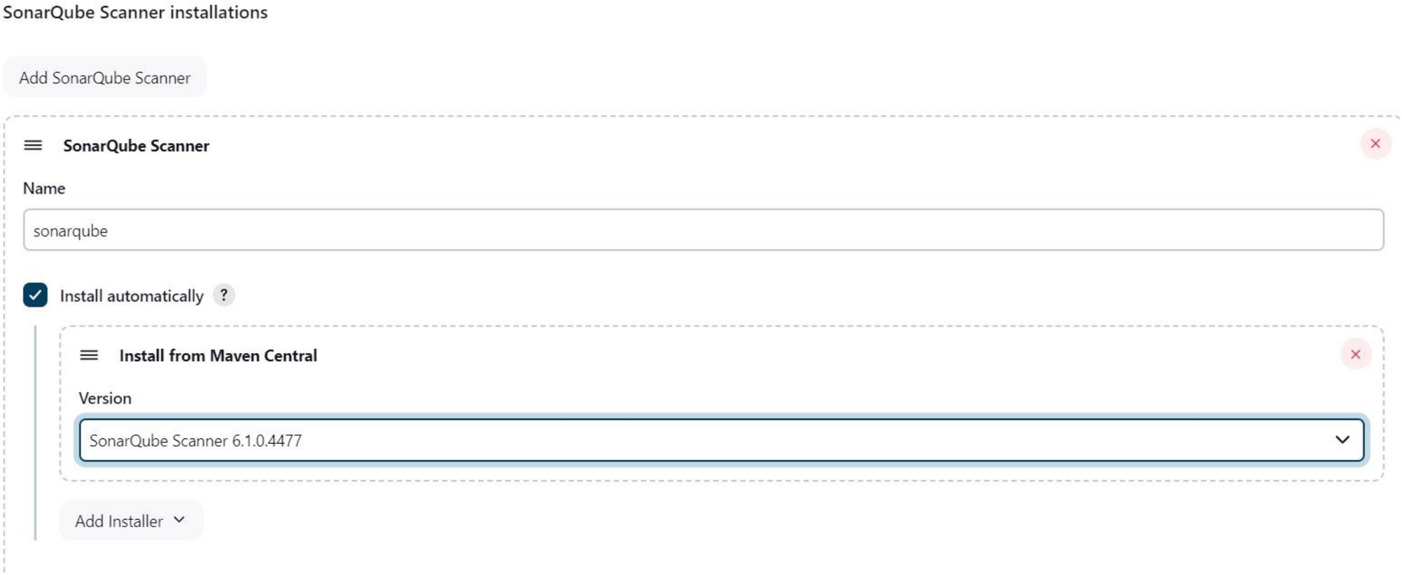
http://localhost:9000

Server authentication token

SonarQube authentication token. Mandatory when anonymous access is disabled.

- none -

8. Search for SonarQube Scanner under Global Tool Configuration. Choose the latest configuration and choose Install automatically.


SonarQube Scanner installations

SonarQube Scanner

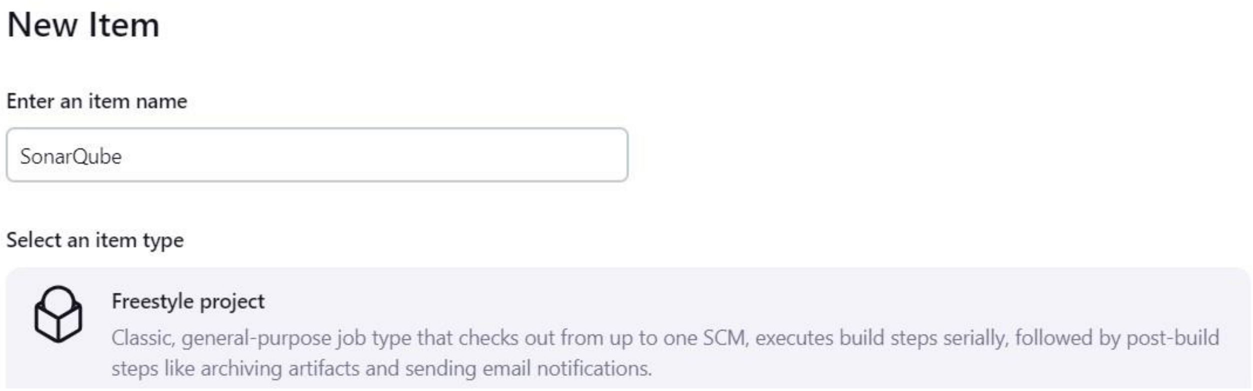
Name: sonarqube

☑ Install automatically

Install from Maven Central

Version: SonarQube Scanner 6.1.0.4477

9. After the configuration, create a New Item in Jenkins, choose a freestyle project.



New Item

Enter an item name

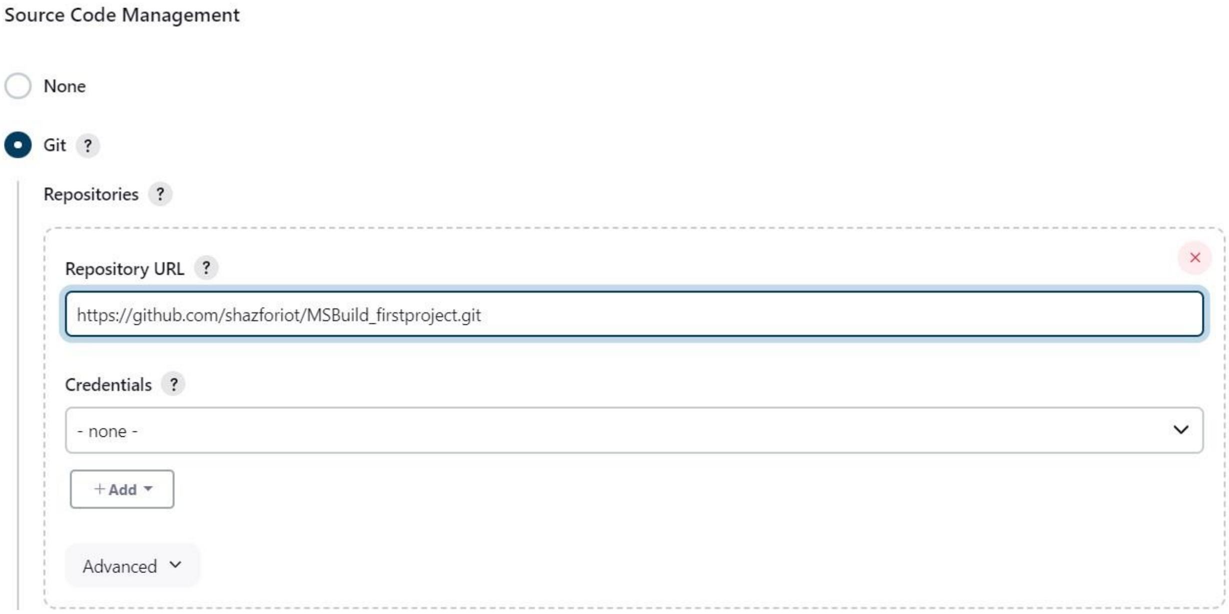
SonarQube

Select an item type

Freestyle project

Classic, general-purpose job type that checks out from up to one SCM, executes build steps serially, followed by post-build steps like archiving artifacts and sending email notifications.

10. Choose this GitHub repository in Source Code Management.
https://github.com/shazforiot/MSBuild_firstproject.git



Source Code Management

○ None

● Git

Repositories

Repository URL

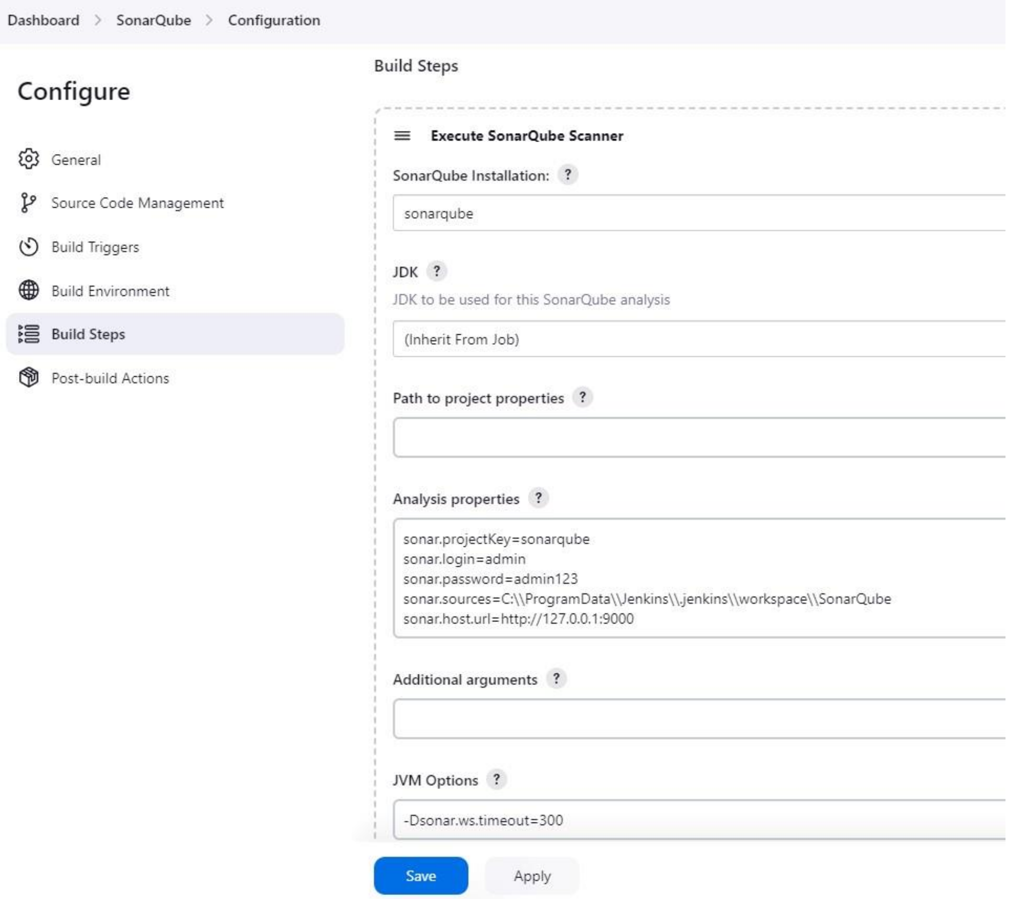
https://github.com/shazforiot/MSBuild_firstproject.git

Credentials

- none -

It is a sample hello-world project with no vulnerabilities and issues, just to test the integration.

11. Under Build-> Execute SonarQube Scanner, enter these Analysis properties. Mention the SonarQube Project Key, Login, Password, Source path and Host URL.



Execute SonarQube Scanner

SonarQube Installation: sonarqube

JDK — JDK to be used for this SonarQube analysis: (Inherit From Job)

Path to project properties:

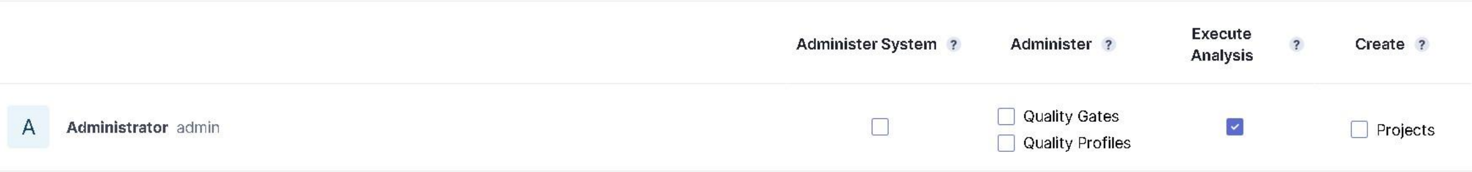
Analysis properties:

```
sonar.projectKey=sonarqube
sonar.login=admin
sonar.password=admin123
sonar.sources=C:\\ProgramData\\Jenkins\\.jenkins\\workspace\\SonarQube
sonar.host.url=http://127.0.0.1:9000
```

Additional arguments:

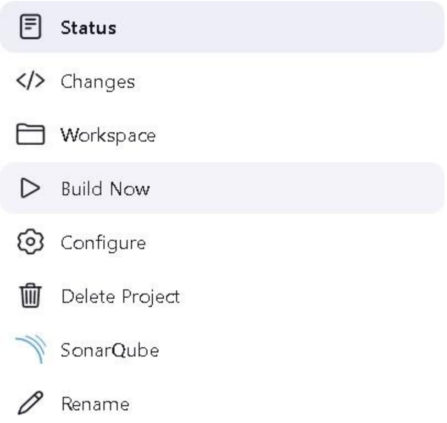
JVM Options: -Dsonar.ws.timeout=300

12. Go to http://localhost:9000/<user_name>/permissions and allow Execute Permissions to the Admin user.

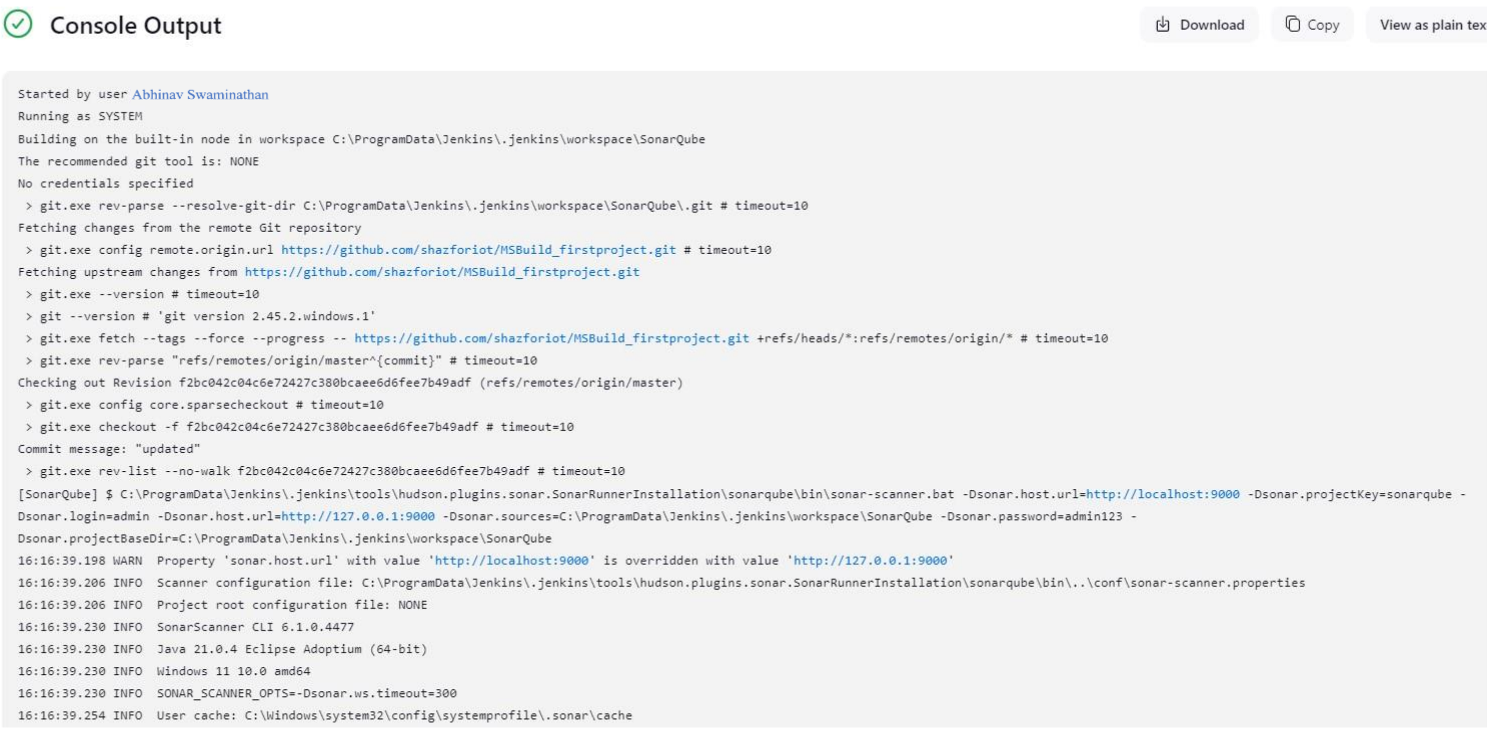


	Administer System ?	Administer ?	Execute Analysis ?	Create ?
A Administrator admin	□	□ Quality Gates □ Quality Profiles	☑	□ Projects

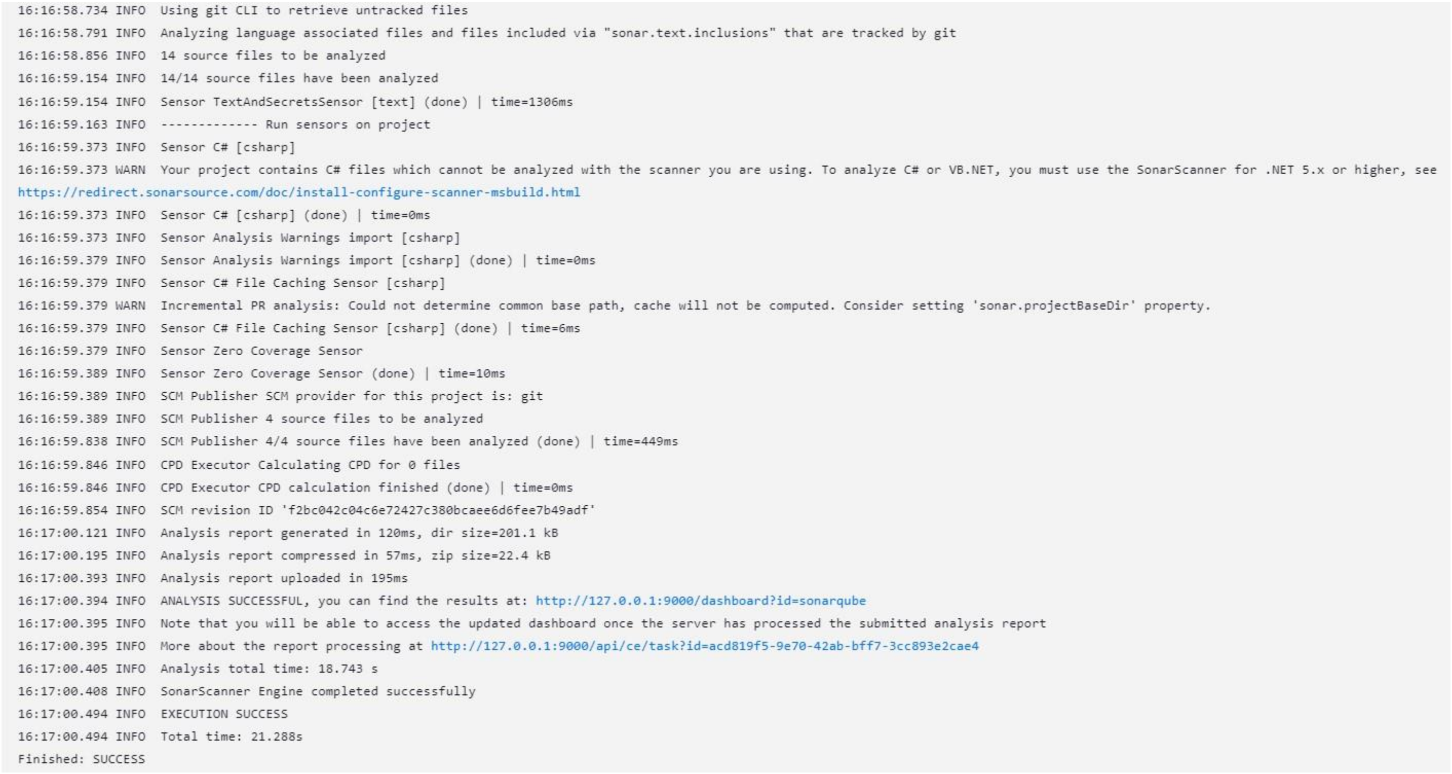
13. Run The Build.



Check the console output.

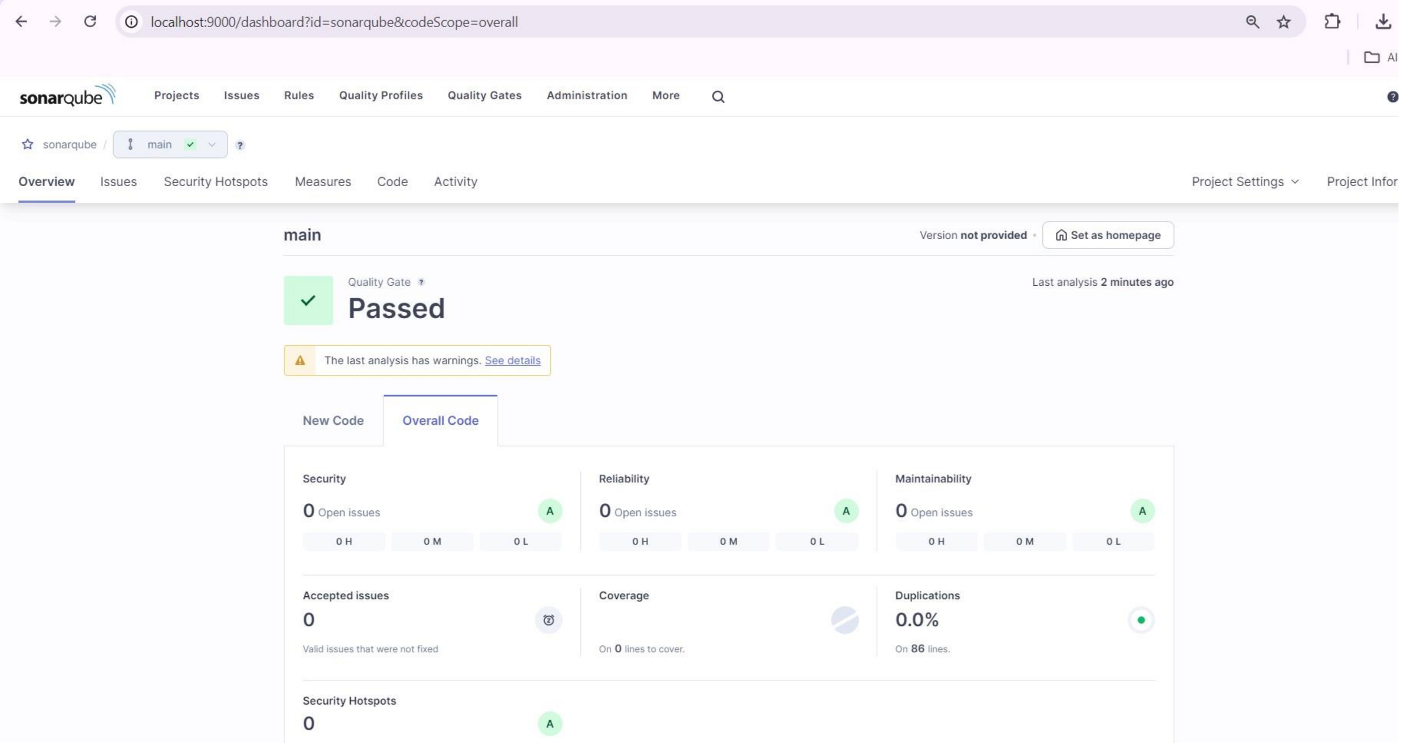


```
Started by user Abhinav Swaminathan
Running as SYSTEM
Building on the built-in node in workspace C:\ProgramData\Jenkins\.jenkins\workspace\SonarQube
The recommended git tool is: NONE
No credentials specified
 > git.exe rev-parse --resolve-git-dir C:\ProgramData\Jenkins\.jenkins\workspace\SonarQube\.git # timeout=10
Fetching changes from the remote Git repository
 > git.exe config remote.origin.url https://github.com/shazforiot/MSBuild_firstproject.git # timeout=10
Fetching upstream changes from https://github.com/shazforiot/MSBuild_firstproject.git
 > git.exe --version # timeout=10
 > git --version # 'git version 2.45.2.windows.1'
 > git.exe fetch --tags --force --progress -- https://github.com/shazforiot/MSBuild_firstproject.git +refs/heads/*:refs/remotes/origin/* # timeout=10
 > git.exe rev-parse "refs/remotes/origin/master^{commit}" # timeout=10
Checking out Revision f2bc042c04c6e72427c380bcaee6d6fee7b49adf (refs/remotes/origin/master)
 > git.exe config core.sparsecheckout # timeout=10
 > git.exe checkout -f f2bc042c04c6e72427c380bcaee6d6fee7b49adf # timeout=10
Commit message: "updated"
 > git.exe rev-list --no-walk f2bc042c04c6e72427c380bcaee6d6fee7b49adf # timeout=10
[SonarQube] $ C:\ProgramData\Jenkins\.jenkins\tools\hudson.plugins.sonar.SonarRunnerInstallation\sonarqube\bin\sonar-scanner.bat -Dsonar.host.url=http://localhost:9000 -Dsonar.projectKey=sonarqube -
Dsonar.login=admin -Dsonar.host.url=http://127.0.0.1:9000 -Dsonar.sources=C:\ProgramData\Jenkins\.jenkins\workspace\SonarQube -Dsonar.password=admin123 -
Dsonar.projectBaseDir=C:\ProgramData\Jenkins\.jenkins\workspace\SonarQube
16:16:39.198 WARN  Property 'sonar.host.url' with value 'http://localhost:9000' is overridden with value 'http://127.0.0.1:9000'
16:16:39.206 INFO  Scanner configuration file: C:\ProgramData\Jenkins\.jenkins\tools\hudson.plugins.sonar.SonarRunnerInstallation\sonarqube\bin\..\conf\sonar-scanner.properties
16:16:39.206 INFO  Project root configuration file: NONE
16:16:39.230 INFO  SonarScanner CLI 6.1.0.4477
16:16:39.230 INFO  Java 21.0.4 Eclipse Adoptium (64-bit)
16:16:39.230 INFO  Windows 11 10.0 amd64
16:16:39.230 INFO  SONAR_SCANNER_OPTS=-Dsonar.ws.timeout=300
16:16:39.254 INFO  User cache: C:\Windows\system32\config\systemprofile\.sonar\cache
```



```
16:16:58.734 INFO  Using git CLI to retrieve untracked files
16:16:58.791 INFO  Analyzing language associated files and files included via "sonar.text.inclusions" that are tracked by git
16:16:58.856 INFO  14 source files to be analyzed
16:16:59.154 INFO  14/14 source files have been analyzed
16:16:59.154 INFO  Sensor TextAndSecretsSensor [text] (done) | time=1306ms
16:16:59.163 INFO  ------------- Run sensors on project
16:16:59.373 INFO  Sensor C# [csharp]
16:16:59.373 WARN  Your project contains C# files which cannot be analyzed with the scanner you are using. To analyze C# or VB.NET, you must use the SonarScanner for .NET 5.x or higher, see
https://redirect.sonarsource.com/doc/install-configure-scanner-msbuild.html
16:16:59.373 INFO  Sensor C# [csharp] (done) | time=0ms
16:16:59.373 INFO  Sensor Analysis Warnings import [csharp]
16:16:59.379 INFO  Sensor Analysis Warnings import [csharp] (done) | time=0ms
16:16:59.379 INFO  Sensor C# File Caching Sensor [csharp]
16:16:59.379 WARN  Incremental PR analysis: Could not determine common base path, cache will not be computed. Consider setting 'sonar.projectBaseDir' property.
16:16:59.379 INFO  Sensor C# File Caching Sensor [csharp] (done) | time=6ms
16:16:59.379 INFO  Sensor Zero Coverage Sensor
16:16:59.389 INFO  Sensor Zero Coverage Sensor (done) | time=10ms
16:16:59.389 INFO  SCM Publisher SCM provider for this project is: git
16:16:59.389 INFO  SCM Publisher 4 source files to be analyzed
16:16:59.838 INFO  SCM Publisher 4/4 source files have been analyzed (done) | time=449ms
16:16:59.846 INFO  CPD Executor Calculating CPD for 0 files
16:16:59.846 INFO  CPD Executor CPD calculation finished (done) | time=0ms
16:16:59.854 INFO  SCM revision ID 'f2bc042c04c6e72427c380bcaee6d6fee7b49adf'
16:17:00.121 INFO  Analysis report generated in 120ms, dir size=201.1 kB
16:17:00.195 INFO  Analysis report compressed in 57ms, zip size=22.4 kB
16:17:00.393 INFO  Analysis report uploaded in 195ms
16:17:00.394 INFO  ANALYSIS SUCCESSFUL, you can find the results at: http://127.0.0.1:9000/dashboard?id=sonarqube
16:17:00.395 INFO  Note that you will be able to access the updated dashboard once the server has processed the submitted analysis report
16:17:00.395 INFO  More about the report processing at http://127.0.0.1:9000/api/ce/task?id=acd819f5-9e70-42ab-bff7-3cc893e2cae4
16:17:00.405 INFO  Analysis total time: 18.743 s
16:17:00.408 INFO  SonarScanner Engine completed successfully
16:17:00.494 INFO  EXECUTION SUCCESS
16:17:00.494 INFO  Total time: 21.288s
Finished: SUCCESS
```

14. Once the build is complete, check the project in SonarQube.



main

Version **not provided**

Quality Gate

Passed

Last analysis **2 minutes ago**

The last analysis has warnings. See details

Security: 0 Open issues — A — 0 H, 0 M, 0 L

Reliability: 0 Open issues — A — 0 H, 0 M, 0 L

Maintainability: 0 Open issues — A — 0 H, 0 M, 0 L

Accepted issues: 0 — Valid issues that were not fixed

Coverage — On **0** lines to cover.

Duplications: 0.0% — On **86** lines.

Security Hotspots: 0 — A

In this way, we have integrated Jenkins with SonarQube for SAST.

Conclusion:

In this experiment, the integration of Jenkins with SonarQube for performing Static Application Security Testing (SAST) was explored. SonarQube was set up within a Docker container, and Jenkins was configured to utilize the SonarQube scanner.

By creating a manual project in SonarQube and configuring the necessary authentication and tools in Jenkins, a seamless connection was established between Jenkins and SonarQube for static code analysis.

The integration was tested using a sample GitHub repository, successfully executing a build and analyzing the project's code quality through SonarQube.

This process provided valuable insights into the SAST process, Jenkins automation, and SonarQube's capabilities in identifying potential code vulnerabilities.