Continuous Integration Testing: circleci

1. Introduction:

Continuous Integration (CI) is a software development practice where developers frequently merge their code changes into a central repository, after which automated builds and tests run.

Continuous integration (CI) is a software development strategy that improves both the speed and quality of code deployments. In CI, developers frequently commit code changes, often several times a day. Each change triggers an automated build and test sequence, ensuring that new code works with the existing codebase. If any issues are discovered during the test phase, the CI platform blocks the code from merging and alerts the team so they can quickly fix any errors.

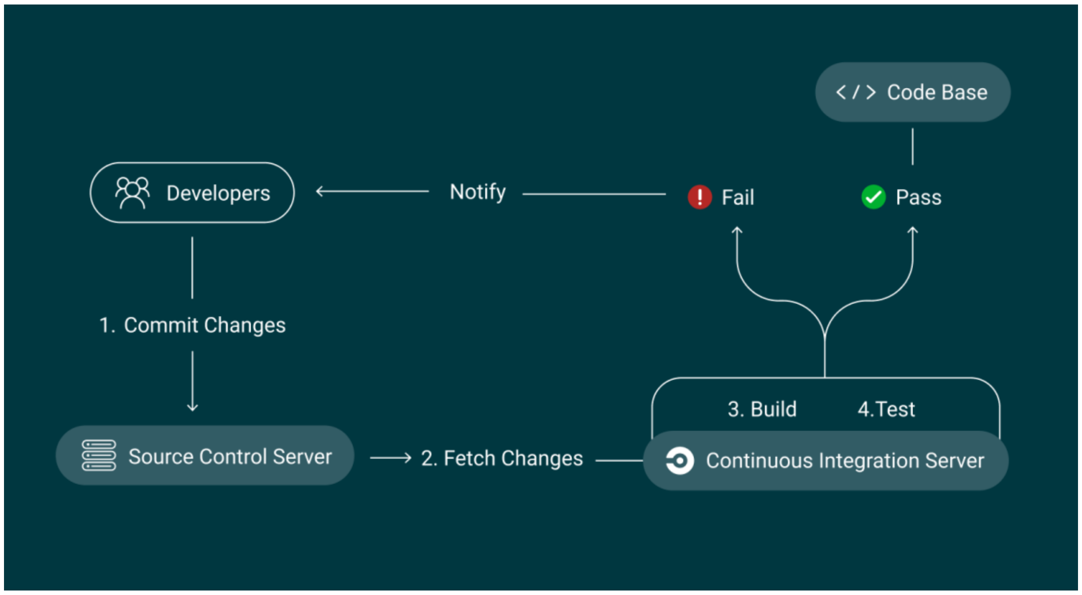


Figure 1: Continuous Integration (CI) Workflow Diagram

The above diagram depicts a Continuous Integration (CI) workflow diagram.

Here’s a description of diagram and it’s elements:

1. **Developers:**
   The process begins with developers making changes to the codebase. This step is labeled as "1. Commit Changes."
2. **Source Control Server:**
   Once the developers commit their changes, these changes are stored in the Source Control Server.
   The diagram labels this as "2. Fetch Changes," indicating that the CI server fetches the latest changes from the source control.
3. **Continuous Integration Server:**
   The CI server retrieves the latest changes and starts the CI pipeline. This stage includes two primary steps:
   Step 1: Build
   The system builds the code to ensure it compiles correctly.
   Step 2: Test
   Automated tests are run to validate the correctness of the code.
4. **Pass/Fail Branch:**
   The diagram then splits into two outcomes after testing:
   Pass: If the tests pass, the process moves forward, and the code is successfully integrated.
   Fail: If the tests fail, the CI server notifies the developers, and they must resolve the issues before proceeding.

This process ensures that code changes are continuously integrated and tested, helping to maintain code quality and reduce integration issues.

2. How Continuous Integration Works

CI is a way to build software faster and better by automating repetitive tasks. It helps prevent errors and makes the development process more efficient. Here’s a step-by-step look at how it works:

1. **Commit:**
   Developers continuously push their code changes to a shared repository, often multiple times a day. This practice ensures that new code is consistently integrated with the existing codebase.

2. **Build:**
   Once code changes are committed, CI systems automatically build the application. This ensures that the new code works with the existing codebase and that the application is deploy-ready at all times.
3. **Test:**
   After the build process, the CI server runs automated tests to assess the changes' impact on the application's functionality, security, and adherence to your organization's policies. Common tests include unit tests, integration tests, security and compliance scans, and code quality checks.
4. **Inform:**
   CI provides rapid feedback to development teams regarding the success or failure of their code changes. This information keeps developers constantly informed about the health of their application, enabling them to iterate quickly and with greater confidence.
5. **Integrate:**
   Once the build and test processes complete successfully, the changes are automatically merged into the main branch. This step ensures that updates are available to all team members and that the mainline stays up to date with the latest working version.
6. **Deploy:**
   CI is often combined with continuous delivery (CD), creating an automated deployment pipeline. Once the code passes all tests, it can be automatically deployed to staging environments for further evaluation or sent directly to production, depending on the organization's policies.

3. CI/CD Tools:

1. **Jenkins**
2. **CircleCI**
3. **GitLab CI**
4. **GitHub Actions**
5. **Travis CI**
6. **TeamCity**
7. **Azure Devops**

Now I am writing about the benefits of using **circleci** for continuous integration and also discussing how to build a CI/CD pipeline with **circleci**:

4. Key advantages of using CircleCI for CI/CD pipelines

CircleCI is a popular continuous integration and continuous delivery (CI/CD) platform that offers several advantages for developers and organizations looking to automate their software development lifecycle. Here are some key benefits of using CircleCI:

1. **Ease of Setup and Configuration:**
   CircleCI pipelines are configured using simple YAML files, making it easy to define and customize workflows. It provides pre-built configurations for popular languages and frameworks, simplifying the setup process for developers.
2. **Scalability and performance:**
   CircleCI automatically scales infrastructure based on the demands of your project. Whether you're running a few tests or thousands, it can handle the load with minimal delay. It supports parallel job execution, enabling faster builds by distributing tests across multiple containers. It offers robust caching mechanisms to save build dependencies and results, reducing redundant steps in future builds and improving pipeline speed.
3. **Integration with popular tools:**
   CircleCI integrates with popular version control systems (like GitHub, GitLab, Bitbucket), cloud platforms (AWS, GCP, Azure), and other DevOps tools (Slack, Jira, etc.).
4. **Cross-Platform Support:**
   CircleCI supports a wide range of programming languages, build tools, and environments, making it suitable for teams. It supports Linux, macOS, and Windows, which is useful for testing software across different operating systems.

5. How to build a CI/CD pipeline with circleci:

Continuous Integration (CI) is employed to determine whether incorporating a smaller module into the broader project will cause any problems or conflicts with the existing codebase.

A CI pipeline is triggered by code changes and verifies the compatibility of all modifications with the rest of the code. It includes steps for compiling, testing, and ensuring the code's functionality.

In this guide, we will walk through the steps to set up a CI/CD pipeline for your Android Studio project using CircleCI and GitHub. This setup will automate building, testing, and deploying our Android app whenever you push code to your GitHub repository.

Prerequisites:

1. A GitHub account and repository for your Android project.
2. CircleCI account connected to your GitHub account.
3. Android Studio with a project ready for integration.

Step 1: Create a GitHub Repository and Push Android Project

- Create a new GitHub repository for your android project.
- Push your android project to GitHhub.

Step 2: Create a CircleCI Account and Link Your GitHub Repo

1. Sign Up for CircleCI
2. Link GitHub repository to CircleCI
   2.1 Once logged in, click Projects in CircleCI.

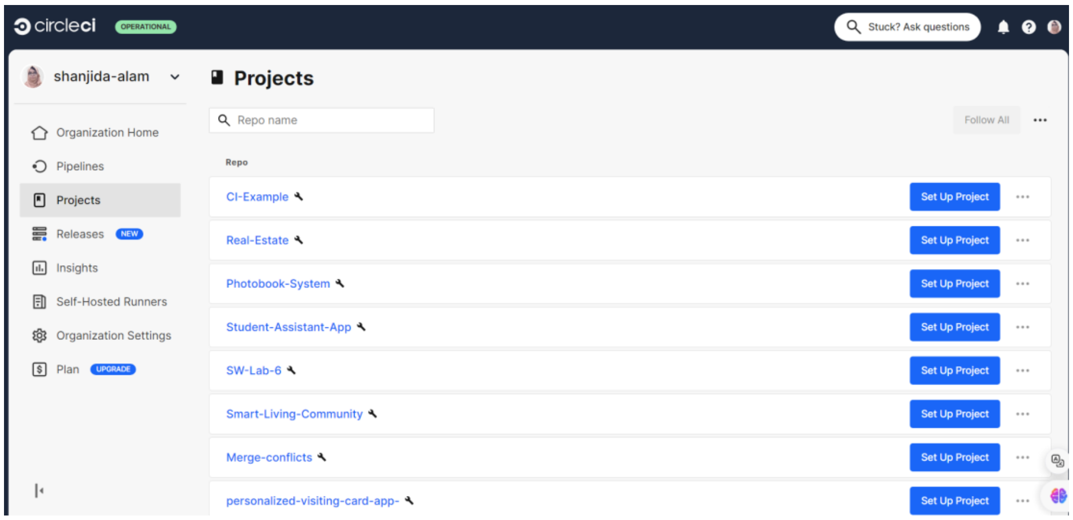


Figure 2: CircleCI dashboard showing a list of projects.

   2.2 Click **Set Up Project** next to your Android repository.

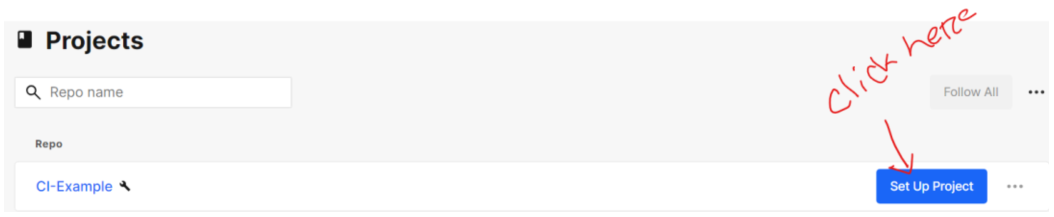


Figure 3: Click 'Set Up Project' to start your CI/CD workflow on CircleCI.

2.3 CircleCI will suggest creating a `.circleci/config.yml` file.

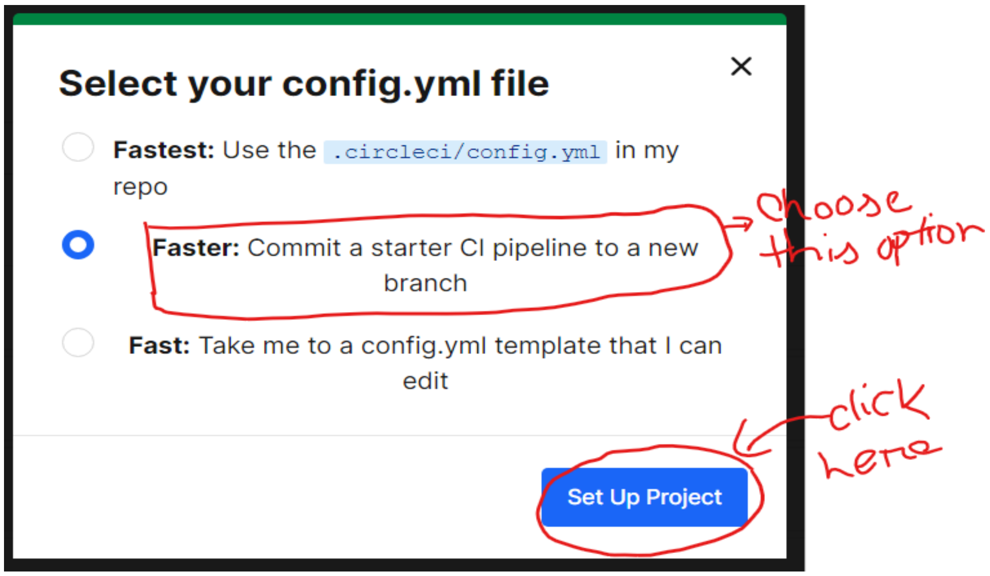
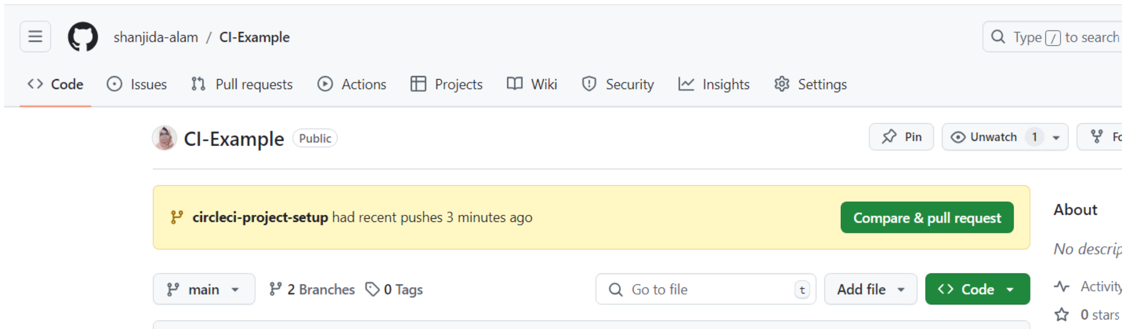

Select your config.yml file
Fastest: Use the .circleci/config.yml in my repo
Faster: Commit a starter CI pipeline to a new branch
Fast: Take me to a config.yml template that I can edit
Set Up Project
Choose this option
click here

Figure 4:Configuring your project on CircleCI: select the faster option.

Step 3: Create a CircleCI Configuration File (`config.yml`)

The CircleCI pipeline for Android Studio projects is defined by a `.circleci/config.yml` file in the root of your project. This file tells CircleCI how to build, test, and deploy your Android app.

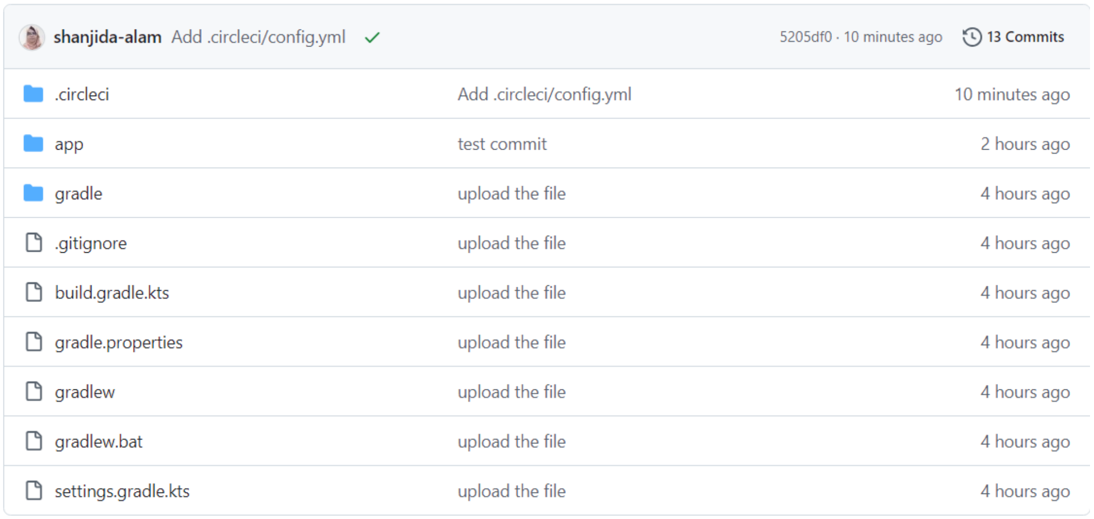


circleci-project-setup had recent pushes 3 minutes ago

Figure 5:Viewing recent activity on the circleci-project-setup branch after creating a config.yml file

3.1 Creating the `.circleci` Folder:

- In the root directory of your Android project, create a folder named `.circleci`.
- Inside that folder, create a file named `config.yml`.



shanjida-alam Add .circleci/config.yml ✓ 5205df0 · 10 minutes ago 13 Commits

.circleci	Add .circleci/config.yml	10 minutes ago
app	test commit	2 hours ago
gradle	upload the file	4 hours ago
.gitignore	upload the file	4 hours ago
build.gradle.kts	upload the file	4 hours ago
gradle.properties	upload the file	4 hours ago
gradlew	upload the file	4 hours ago
gradlew.bat	upload the file	4 hours ago
settings.gradle.kts	upload the file	4 hours ago

Figure 6:Recent commit on the circleci-project-setup branch: adding the `.circleci/config.yml` file.

3.2 Add a Basic Android CI Configuration:

- **Pull the latest code** in your android project and then update the `config.yml` with the following code.
- Then, **switch the new branch** where introduced the `.circleci/config` file.
  `‘git checkout circleci-project-setup’`

Here’s a simple `config.yml` file that you can start with:

```yaml
version: 2.1

executors:
  android-executor:
    docker:
      - image: circleci/android:api-30
    working_directory: ~/project

jobs:
  build:
    executor: android-executor
    steps:
      - checkout

      # Install SDKMAN! to manage JDK versions
      - run:
          name: Install SDKMAN
          command: |
            curl -s "https://get.sdkman.io" | bash
            source "$HOME/.sdkman/bin/sdkman-init.sh"

      # Install Java 17 via SDKMAN and set it as the
default
      - run:
          name: Install JDK 17
          command: |
            source "$HOME/.sdkman/bin/sdkman-init.sh"
            sdk install java 17.0.8-zulu
            sdk use java 17.0.8-zulu  # Explicitly use Java
17

      # Set JAVA_HOME to point to Java 17
      - run:
          name: Set JAVA_HOME to Java 17
          command: |
            echo 'export
JAVA_HOME=$HOME/.sdkman/candidates/java/current' >>
$BASH_ENV
            source $BASH_ENV

      # Verify Java 17 is the active version
      - run:
          name: Verify Java Version
          command: java -version

      # Set executable permission for gradlew
      - run:
          name: Set executable permission for gradlew
          command: chmod +x ./gradlew

      # Download dependencies
      - run:
          name: Download Dependencies
          command: ./gradlew dependencies
      # Build the APK
      - run:
          name: Build APK
          command: ./gradlew assembleDebug

      # Store the APK as an artifact
      - store_artifacts:
          path: app/build/outputs/apk/debug/app-debug.apk
          destination: app-debug.apk

  test:
    executor: android-executor
    steps:
      - checkout

      # Install SDKMAN! to manage JDK versions
      - run:
          name: Install SDKMAN
          command: |
            curl -s "https://get.sdkman.io" | bash
            source "$HOME/.sdkman/bin/sdkman-init.sh"

      # Install Java 17 via SDKMAN and set it as the
default
      - run:
          name: Install JDK 17
          command: |
            source "$HOME/.sdkman/bin/sdkman-init.sh"
            sdk install java 17.0.8-zulu
            sdk use java 17.0.8-zulu  # Explicitly use Java
17

      # Set JAVA_HOME to point to Java 17
      - run:
          name: Set JAVA_HOME to Java 17
          command: |
            echo 'export
JAVA_HOME=$HOME/.sdkman/candidates/java/current' >>
$BASH_ENV
            source $BASH_ENV

      # Verify Java 17 is the active version
      - run:
          name: Verify Java Version
          command: java -version

      # Set executable permission for gradlew
      - run:
          name: Set executable permission for gradlew
          command: chmod +x ./gradlew

      # Run unit tests
      - run:
          name: Run Unit Tests
          command: ./gradlew testDebug
      # Store test results
      - store_test_results:
          path: app/build/test-results/testDebugUnitTest

workflows:
  version: 2
  build_and_test:
    jobs:
      - build
      - test
```

Step 4: Commit and Push Changes

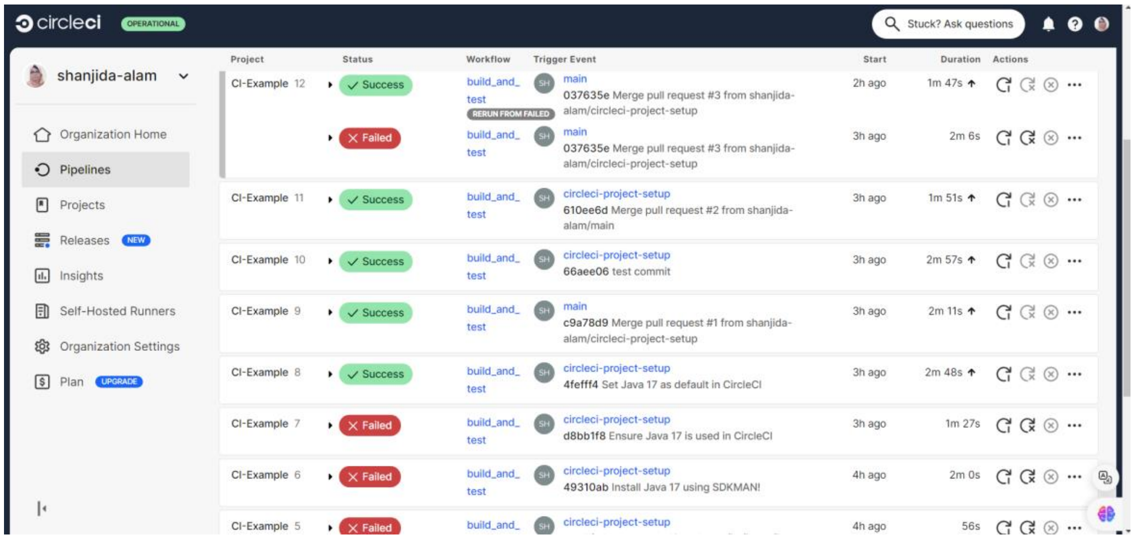
4.1 Commit the new CircleCI configuration:

```
git add .circleci/config.yml
git commit -m "Add CircleCI config for
Android project"
git push origin main
```

Once the configuration is pushed to your repository, CircleCI will detect it and start the build process automatically.

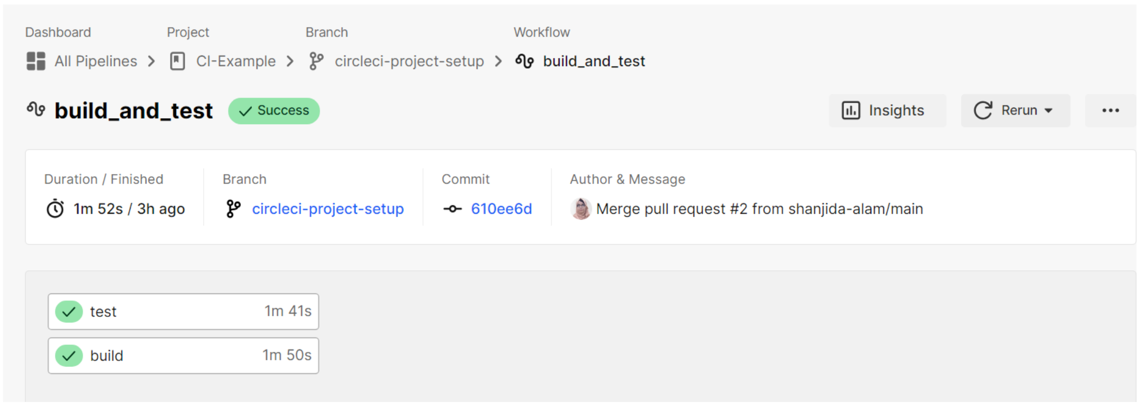
Step 5: Monitor the Build on CircleCI

Go to your CircleCI dashboard, where you can see the pipeline running based on your `.circleci/config.yml` file.



Project	Status	Workflow	Trigger Event	Start	Duration	Actions
CI-Example 12	✓ Success	build_and_test RERUN FROM FAILED	main 037635e Merge pull request #3 from shanjida-alam/circleci-project-setup	2h ago	1m 47s	
	✕ Failed	build_and_test	main 037635e Merge pull request #3 from shanjida-alam/circleci-project-setup	3h ago	2m 6s	
CI-Example 11	✓ Success	build_and_test	circleci-project-setup 610ee6d Merge pull request #2 from shanjida-alam/main	3h ago	1m 51s	
CI-Example 10	✓ Success	build_and_test	circleci-project-setup 66aee06 test commit	3h ago	2m 57s	
CI-Example 9	✓ Success	build_and_test	main c9a78d9 Merge pull request #1 from shanjida-alam/circleci-project-setup	3h ago	2m 11s	
CI-Example 8	✓ Success	build_and_test	circleci-project-setup 4fefff4 Set Java 17 as default in CircleCI	3h ago	2m 48s	
CI-Example 7	✕ Failed	build_and_test	circleci-project-setup d8bb1f8 Ensure Java 17 is used in CircleCI	3h ago	1m 27s	
CI-Example 6	✕ Failed	build_and_test	circleci-project-setup 49310ab Install Java 17 using SDKMAN!	4h ago	2m 0s	
CI-Example 5	✕ Failed	build_and_	circleci-project-setup	4h ago	56s	

Figure 7:Tracking recent build and test results on CircleCI.

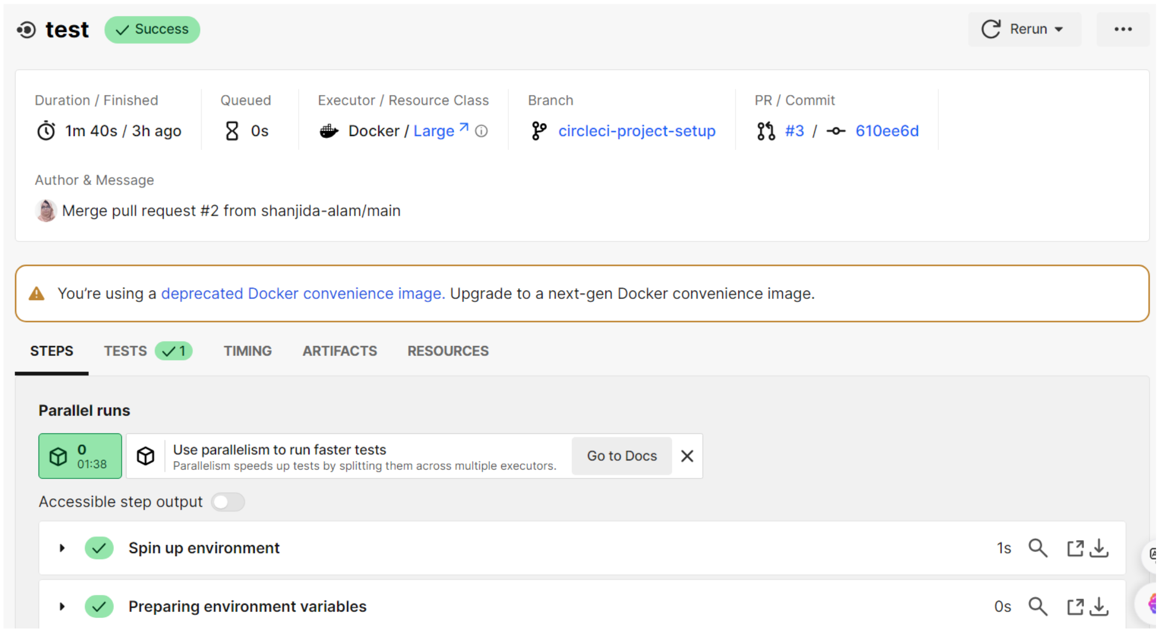

Dashboard Project Branch Workflow
All Pipelines > CI-Example > circleci-project-setup > build_and_test

build_and_test ✓ Success

Duration / Finished	Branch	Commit	Author & Message
1m 52s / 3h ago	circleci-project-setup	610ee6d	Merge pull request #2 from shanjida-alam/main

✓ test	1m 41s
✓ build	1m 50s

Figure 8: CircleCI pipeline details for the build_and_test workflow.


test ✓ Success

Duration / Finished	Queued	Executor / Resource Class	Branch	PR / Commit
1m 40s / 3h ago	0s	Docker / Large	circleci-project-setup	#3 / 610ee6d

Author & Message
Merge pull request #2 from shanjida-alam/main

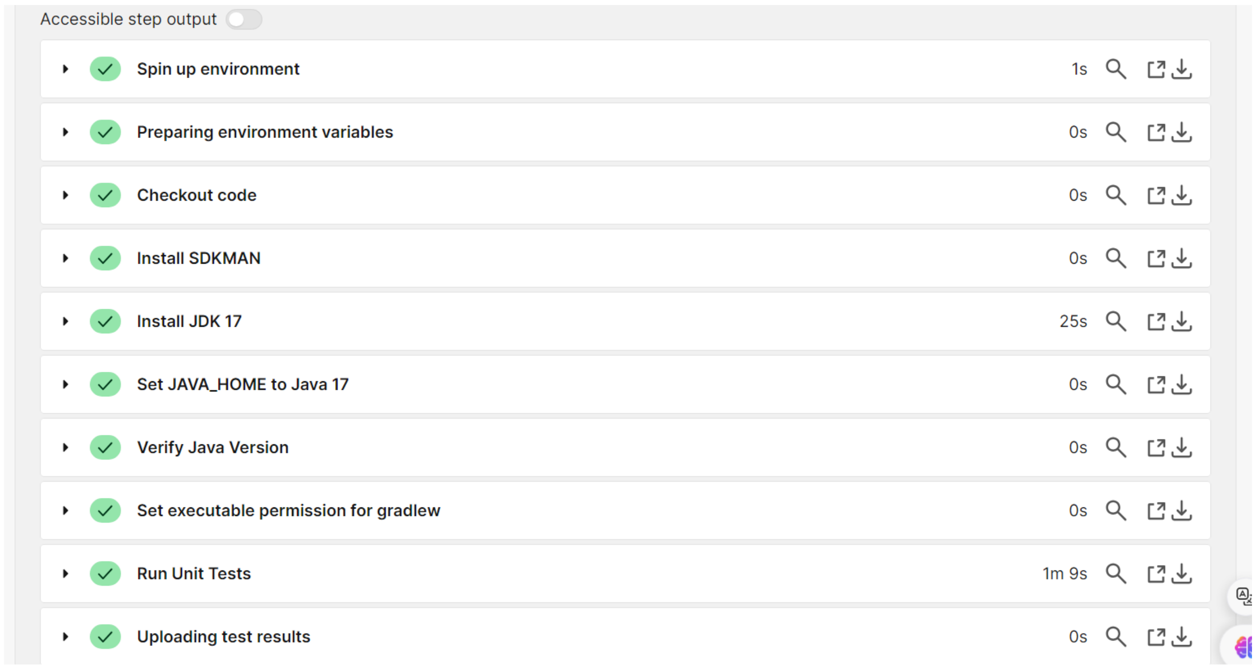
You're using a deprecated Docker convenience image. Upgrade to a next-gen Docker convenience image.

STEPS TESTS ✓1 TIMING ARTIFACTS RESOURCES

Parallel runs
0 01:38
Use parallelism to run faster tests
Parallelism speeds up tests by splitting them across multiple executors.
Go to Docs

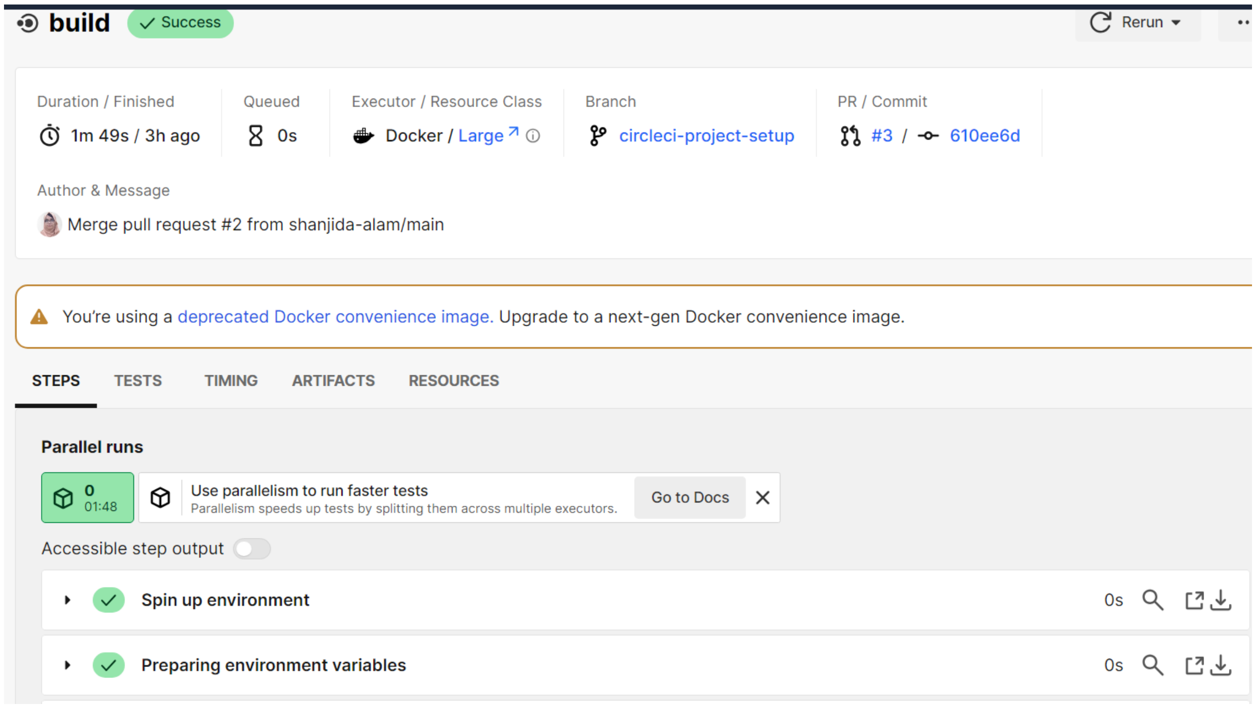
Accessible step output

✓ Spin up environment	1s
✓ Preparing environment variables	0s


Accessible step output

✓ Spin up environment	1s
✓ Preparing environment variables	0s
✓ Checkout code	0s
✓ Install SDKMAN	0s
✓ Install JDK 17	25s
✓ Set JAVA_HOME to Java 17	0s
✓ Verify Java Version	0s
✓ Set executable permission for gradlew	0s
✓ Run Unit Tests	1m 9s
✓ Uploading test results	0s

Figure 9:Viewing detailed step output for a successful CircleCI pipeline.


build ✓ Success Rerun

Duration / Finished	Queued	Executor / Resource Class	Branch	PR / Commit
1m 49s / 3h ago	0s	Docker / Large	circleci-project-setup	#3 / 610ee6d

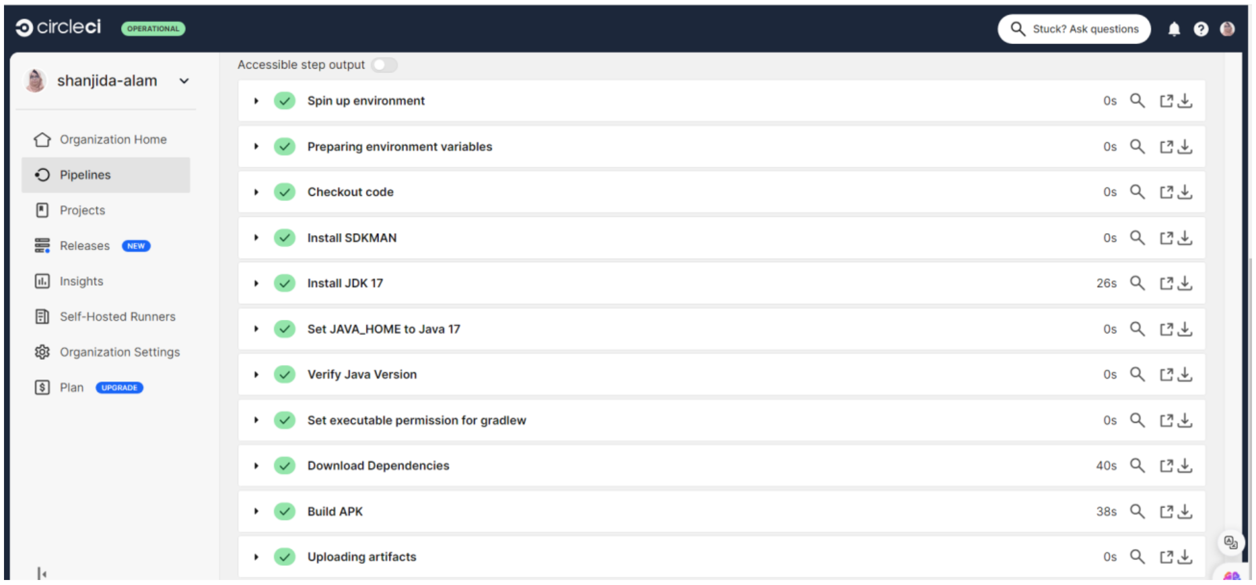
Author & Message
Merge pull request #2 from shanjida-alam/main

You're using a deprecated Docker convenience image. Upgrade to a next-gen Docker convenience image.

Parallel runs
0 01:48
Use parallelism to run faster tests
Parallelism speeds up tests by splitting them across multiple executors.
Go to Docs

Accessible step output

✓ Spin up environment	0s
✓ Preparing environment variables	0s



```
Spin up environment                          0s
Preparing environment variables              0s
Checkout code                                0s
Install SDKMAN                               0s
Install JDK 17                              26s
Set JAVA_HOME to Java 17                     0s
Verify Java Version                          0s
Set executable permission for gradlew        0s
Download Dependencies                       40s
Build APK                                   38s
Uploading artifacts                          0s
```

Figure 10:Successful CircleCI Pipeline Execution for Android Build Process

6. References:

- https://circleci.com/continuous-integration/
- https://youtu.be/qtJqTbf6l18?si=I5hta4q7WLn2gUo-
- https://circleci.com/docs/