MASTER OF SCIENCE
IN ENGINEERING

TSM_AdvEmbSof

Testing Embedded Systems

Serge Ayer | 25.09.2023 | Cours MSE

swissuniversities

Hes·so Master

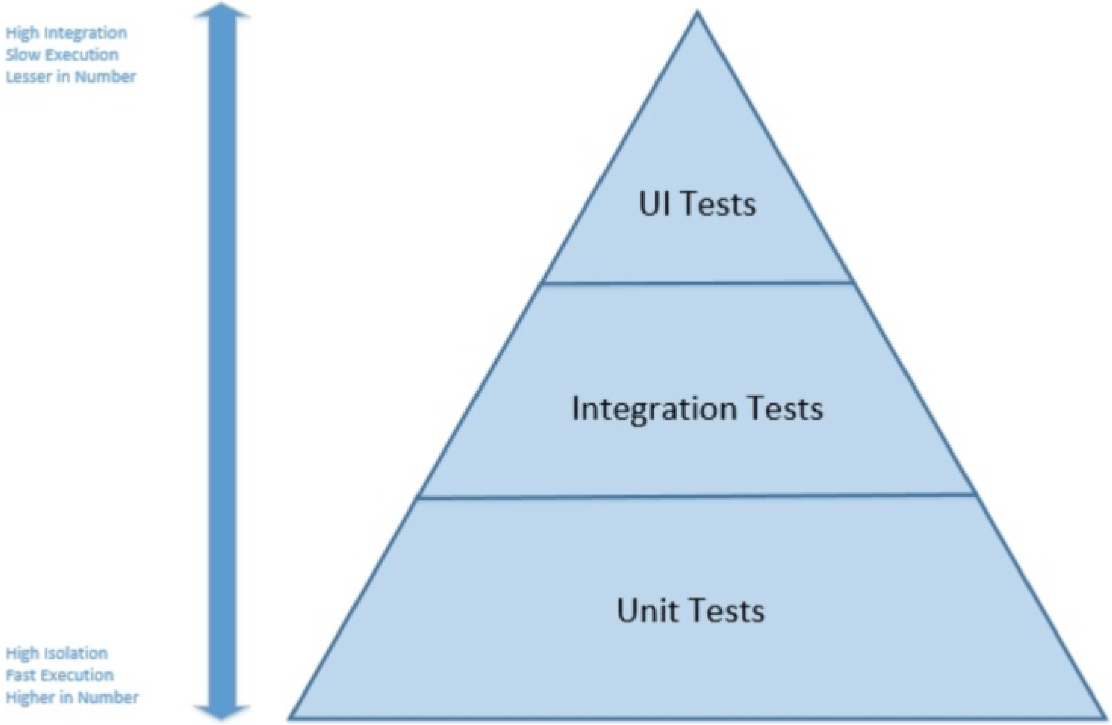
Motivations

- Developers testing the “changes they made” is not enough
  - Interdependencies among software components
  - Dependencies to environment
  - Testing is time-consuming and boring
- Testing must be done so that it:
  - Improve overall quality
  - Does not prevent developers to do their preferred job
  - Is implemented in automated procedures

The pyramid test

Mike Cohn's concept:

- Three hierarchical layers
- The granularity is specific to each layer
- Many tests with fine granularity
- Fewer tests with higher integration



Source: https://www.baeldung.com/

Test performance

- Tests have different granularities and are thus very different
- Good tests however share some characteristics:
  - They are deterministic
  - They are fully-automated
  - They are responsive

Unit tests

- Test single functions or single classes
  - No dependency on the underlying platform or external libraries
  - Use stubs/mocks for isolation from external dependencies
- Can run on any environment
  - Host environment is privileged

Integration tests

- Higher granularity than Unit tests:
  - Dependencies to the underlying platform or external libraries may exist (they usually do exist).
  - Mbed OS: Greentea is the automated testing tool.
- Are run on the target platform:
  - Tool must allow build, flashing, execution and result generation.
    - Integration with a host platform is required
  - Can be controlled from a local host but should also allow automation in a continuous integration environment.

Greentea for Mbed OS

- Allows to run test programs on the target embedded devices
  - Build on the host environment
  - Flashing from the host
  - Run tests on the embedded device
  - Host collects the test results
- Host tests
  - Written as Python scripts that run on a computer
  - Can communicate back to the embedded device.
  - One can, for example, verify that data are correctly sent to a cloud platform.

Codelabs

- Introduction to Mbed and Embedded Software Testing

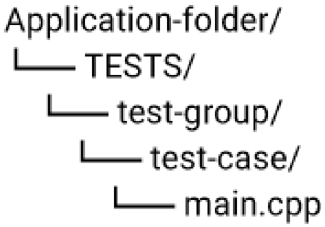
  Introduction to Mbed OS Testing (first sections)

- Start testing by running existing tests

  Start Testing (step 5)

Write Your Own Tests

- Follow a given folder structure
- Use the following frameworks
  - Greentea client
    - Test setup (with host interaction)
  - Unity:
    - Test macros
  - utest:
    - Test cases definition
    - Test execution
    - Reporting handlers



```
Application-folder/
└── TESTS/
    └── test-group/
        └── test-case/
            └── main.cpp
```

Codelabs

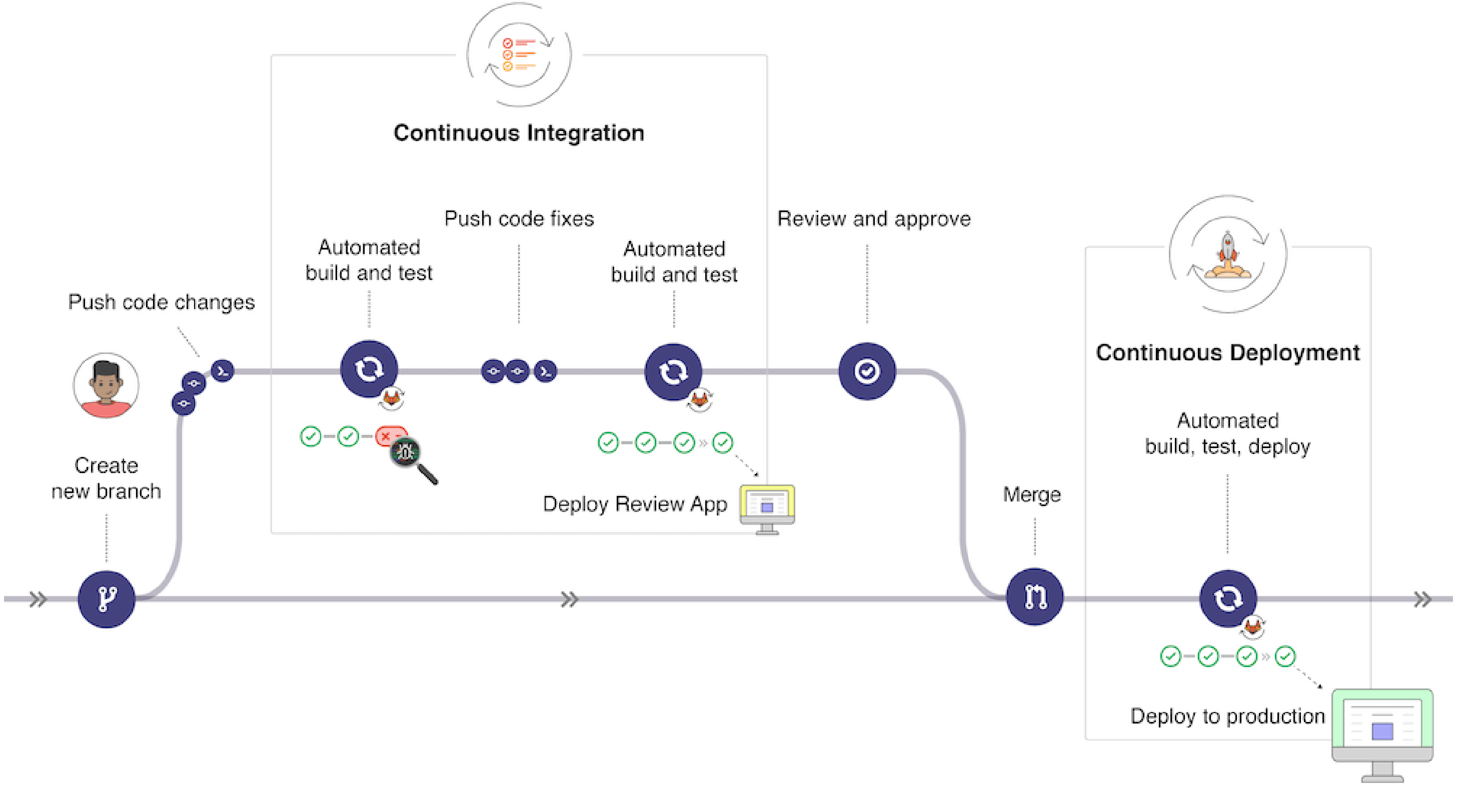
- Write your own test programs

  [Writing Your Own Test Programs]

Test Automation

- Integration into a CI/CD environment
- Improve code quality
  - Spend time in coding rather than in testing
- Enables efficient code improvements
  - Make bugs easily detectable.
  - Safety net for developer
- Make tests that are
  - Deterministic
  - Fully-automated
  - Responsive, with efficient reporting

CI/CD principle



Source: https://docs.gitlab.com/ee/ci/introduction/index.html#continuous-integration

Use Docker Images

- Easy way to get a build environment setup for Mbed OS projects.
  - Includes toolchain, cmake, Greentea.
- Docker images are stored in GitHub packages.
  - Can be used on your desktop
  - Can be used on GitHub
    - Restriction: testing on physical device

Codelabs

- Continuous Integration

  Continuous Integration