Akademy
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Test It!

Unit testing for lazy developers

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Next up...

1. Part 1: Test Theory
2. Part 2: Test Frameworks in KDE
3. Part 3: KDE Build & Test Infrastructure
4. The End

Hey, I did test it and it looks fine!

Good reasons why you want automatic tests:

1. You do not waste time with testing manually. – Again. – And again.
2. Errors are easier to find & to fix if the test is small.
3. Refactoring without tests is THE WAY that leads to regressions.
4. Tests assert behavior that is only written down in documentation (if written down at all).
5. When writing integration tests for a library, you are using the API yourself and see if it is usable.

White Box vs. Black Box

White Box Test You are looking into the class and know its implementation:

- unit tests are typical white box tests
- "you know what might cause trouble, you add checks"
- test scope: only one/a few tightly coupled classes

Black Box Test You are looking at the (public) API and features:

- focus is on the features that are promised
- asserts the contract to the outside world

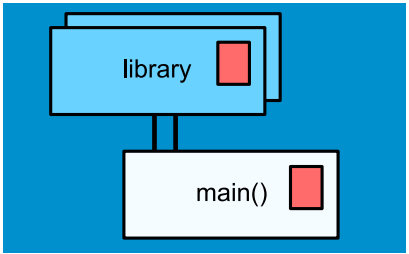
Test Types and Goals

My Definition for System under test

Unit Tests for yourself, to ensure that implementation works

Integration Tests for API user, to ensure that promised functionality works

Subsystem Tests for end-user, to ensure that feature works



System under test

Test-Driven Development (TDD)

- first write a test, then write the code
- then write just enough code that the test passes and repeat
- thus every method is covered by at least one test
- usually results in better code:

  Code Quality you have to think about testability and simplifying the code when writing it

  Architecture leads to better decoupling of classes by interfaces and compositions

  Refactoring you document your assumptions via tests and tests will tell you if still everything works

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QTest

- Lightweight and easy to use framework!
- Every test is an application, which may contain several test cases.
- Test class is a `QObject` and every `Q_SLOT` is interpret as test case
- Provides many convenient test methods:

  QVERIFY: Test if expression is true.
  QCOMPARE: Test if expressions are equal (and state differences if not)
  QSignalSpy: Test if a signal is received and allows to check its parameters

- Documentation
  - Introduction: `https://doc.qt.io/qt-5/qtest-overview.html`
  - All macros: `https://doc.qt.io/qt-5/qtest.html`

QTest: Basic Example


```
1  #include <QTest>
2  class SimpleTest : public QObject {
3      Q_OBJECT
4  private Q_SLOTS:
5      void initTestCase() { /* called before anything else */ }
6      void myTest() {
7          QVERIFY(true);
8          QCOMPARE(1, 1);
9      }
10 }
11 QTEST_MAIN(SimpleTest)
```

Special Slots:

initTestCase(): called **before first** test function

cleanupTestCase(): called **after last** test function

init(): called **before each** test function

cleanup(): called **after each** test function

QTest: Test Emitted Signals

Listing 1: Simple

```
1  QPushButton myPushButton;
2  QSignalSpy spy(&myPushButton, &QPushButton::clicked);
3  QVERIFY(spy.isValid());
4  myPushButton.click();
5  QCOMPARE(spy.count(), 1);
6  QList<QVariant> arguments = spy.takeFirst();
7  QCOMPARE(arguments.at(0).toBool(), false);
```

Listing 2: Concurrency

```
1  QVERIFY(spy.wait(1000)); // start event loop with 1s timeout
```

QTest: Create Data Driven Test


```
1  #include <QTest>
2  class SimpleTest : public QObject
3  {
4      Q_OBJECT
5  private Q_SLOTS:
6      void myTest_data() {
7          QTest::addColumn<QString>("original");
8          QTest::addColumn<QString>("target");
9          QTest::newRow("first case") << "foo" << "foo_target";
10         QTest::newRow("second case") << "baa" << "baa_target";
11     }
12     void myTest() {
13         QFETCH(QString, original);
14         QFETCH(QString, target);
15         Q_EXPECT_FAIL();
16         QCOMPARE(original, target);
17     }
18 }
19 QTEST_MAIN(SimpleTest)
```

QTest: Test QtQuick Bindings

Example for test method with focus on QML Engine interaction:

```
1   void bindingTest() {
2       // test.qml has root object with property "testProperty"
3       QUrl input = QUrl::fromLocalFile(QFINDTESTDATA("test.qml"));
4       QQmlEngine engine;
5       QQmlComponent component(&engine, input, QQmlComponent::
            PreferSynchronous);
6       QObject *object = component.create();
7       if (!object) {
8           qDebug() << "errors:" << component.errors();
9       }
10      QVERIFY(object);
11      QVERIFY(!component.isLoading());
12      QCOMPARE(object->property("testProperty").toString(), "foo");
13  }
```

There is also QtQuickTest for interactive tests, but can be tricky to use.

QTest: Test QtQuick Bindings

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```
1   void bindingTest() {
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```

There is also QtQuickTest for interactive tests, but can be tricky to use.

Test Design

Never ever. . .

1. make one unit test depending on another one
2. test production code, rather then setting up a fake
3. make your tests slow
4. create tests suits to test third party code (if you do not trust, don’t use it)
5. create a test that need dozens of cpp files compiled into to, because then you are missing interfaces and mocks

Good Advice

- If you never spent time learning about software patterns, do it now!
- There is a good reason, why there are mocks, stubs and fakes :)

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Integrate Tests into your Build System

CMake has its own testing tool: CTest

- CTest executes your QTest tests and reports results
- `https://gitlab.kitware.com/cmake/community/-/wikis/doc/ctest/Testing-With-CTest`

Steps to Integrate:

1. in your main CMakeLists.txt: `include(ECMAddTests)`
2. use `ecm_add_test` macro:

```
1   ecm_add_test(<sources> LINK_LIBRARIES <library> [<library> [...]]
2                          [TEST_NAME <name>]
3                          [NAME_PREFIX <prefix>]
4                          [GUI])
```

`https://api.kde.org/ecm/module/ECMAddTests.html`

Executing CTest

Execute in your build directory:

- ctest -N: List all available tests
- ctest -R: Run all tests
- ctest -R -V: Run all tests and print information on problems
- ctest -R --output-on-failure: Runs all tests and gives output for failed tests
- ctest -R foo --output-on-failure: Runs all tests with "foo" in their name and gives output for failed tests
- make test: Runs: `/usr/bin/ctest --force-new-ctest-process`

build.kde.org

We have some great CI tooling:

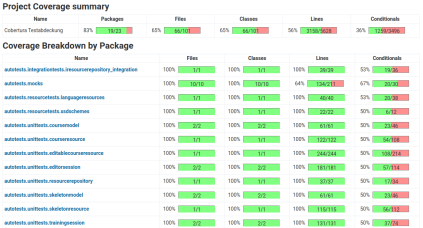
- all (non-playground) projects run on the CI
- building is checked against various architectures
- tests are run on most of this architectures
- this gives an important safety net to see if everything works outside of your own system!
- task for today: check the status of your project! ;)

Keep in mind: Never merge a test that fails on your system.

Test Coverage Computation GCov

Sometimes it is good to not only rely on your feelings...

- GCov is a tool to log which code is executed during a test
- results are generated in CI
- it shows you areas that are forgotten by tests



Project Coverage summary

Name	Packages	Files	Classes	Lines	Conditionals
Coberturs Testabdeckung	83% 15/18	65% 56/101	66% 64/101	56% 1154/2028	36% 1210/3456

Coverage Breakdown by Package

Name	Files	Classes	Lines	Conditionals
autotests.integrationtests.resourcerepository_integration	100% 1/1	100% 1/1	100% 26/26	53% 16/30
autotests.mocks	100% 10/10	100% 10/10	64% 134/211	67% 20/30
autotests.resourcetests.languageresources	100% 1/1	100% 1/1	100% 46/46	53% 20/38
autotests.resourcetests.xsdschemas	100% 1/1	100% 1/1	100% 22/22	50% 6/12
autotests.unittests.coursemodel	100% 2/2	100% 2/2	100% 61/61	50% 23/46
autotests.unittests.courseresource	100% 1/1	100% 1/1	100% 122/122	50% 54/108
autotests.unittests.editablecourseresource	100% 1/1	100% 1/1	100% 244/244	50% 108/214
autotests.unittests.editorsession	100% 2/2	100% 2/2	100% 185/185	50% 57/114
autotests.unittests.resourcerepository	100% 1/1	100% 1/1	100% 37/37	50% 17/34
autotests.unittests.skeletonmodel	100% 2/2	100% 2/2	100% 61/61	50% 23/46
autotests.unittests.skeletonresource	100% 1/1	100% 1/1	100% 115/115	50% 56/112
autotests.unittests.trainingsession	100% 2/2	100% 2/2	100% 131/131	50% 37/74

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Question Time

Contact

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