Writing tests that stand the test of time

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Outline

Introduction to TDD

Challenges with TDD

Testing tools in practice

Writing maintainable tests

Recap

Introduction

So, what's Test Driven Development?

“

TDD is a software development process that relies on the repetition of a very short development cycle: requirements are turned into very specific test cases, then the software is improved to pass the new tests, only

Wikipedia

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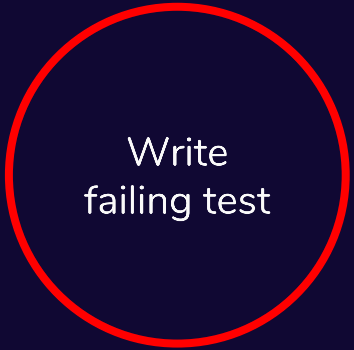
Wikipedia

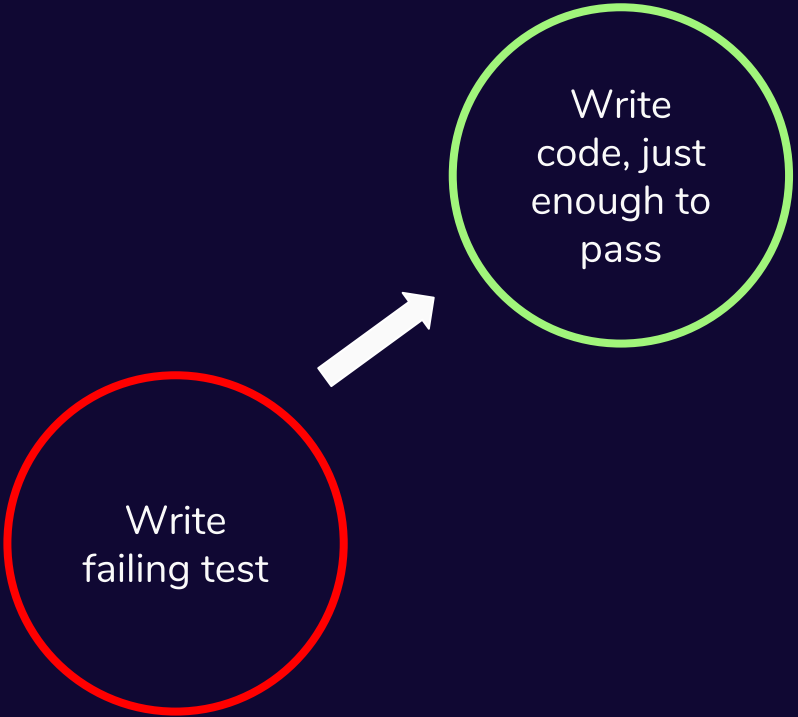
How to do TDD?

Red - Green - Refactor

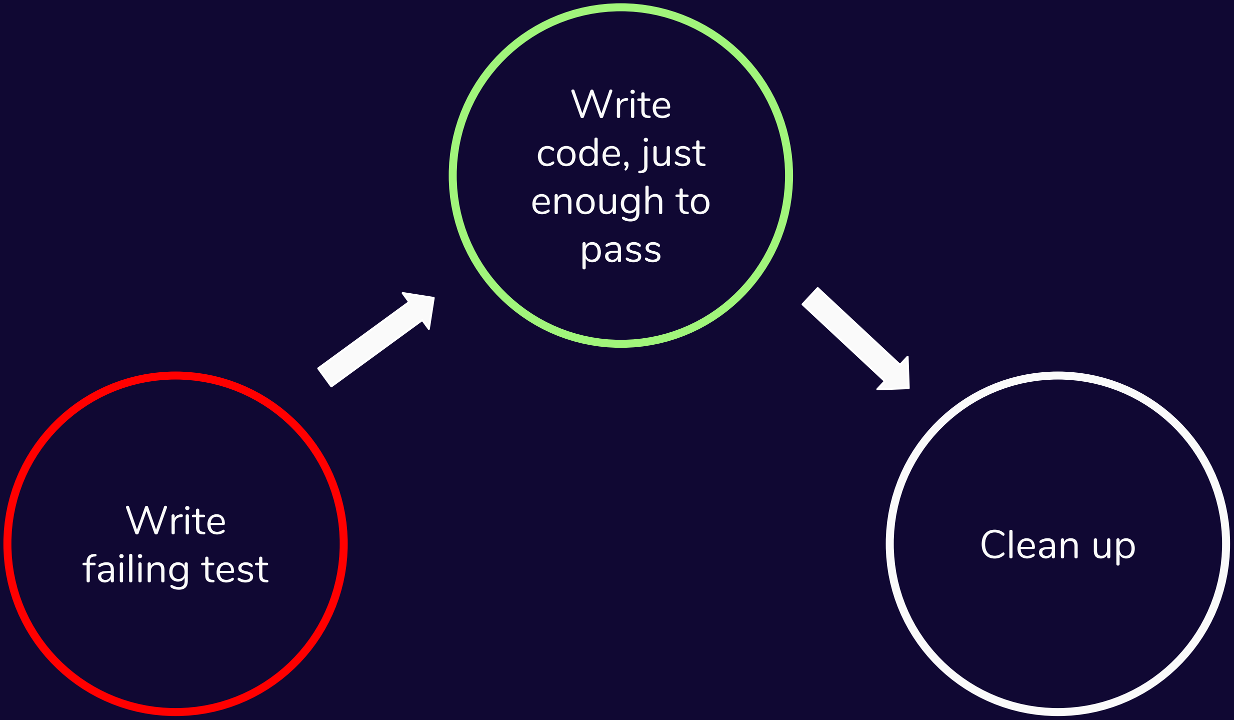
Red - Green - Refactor



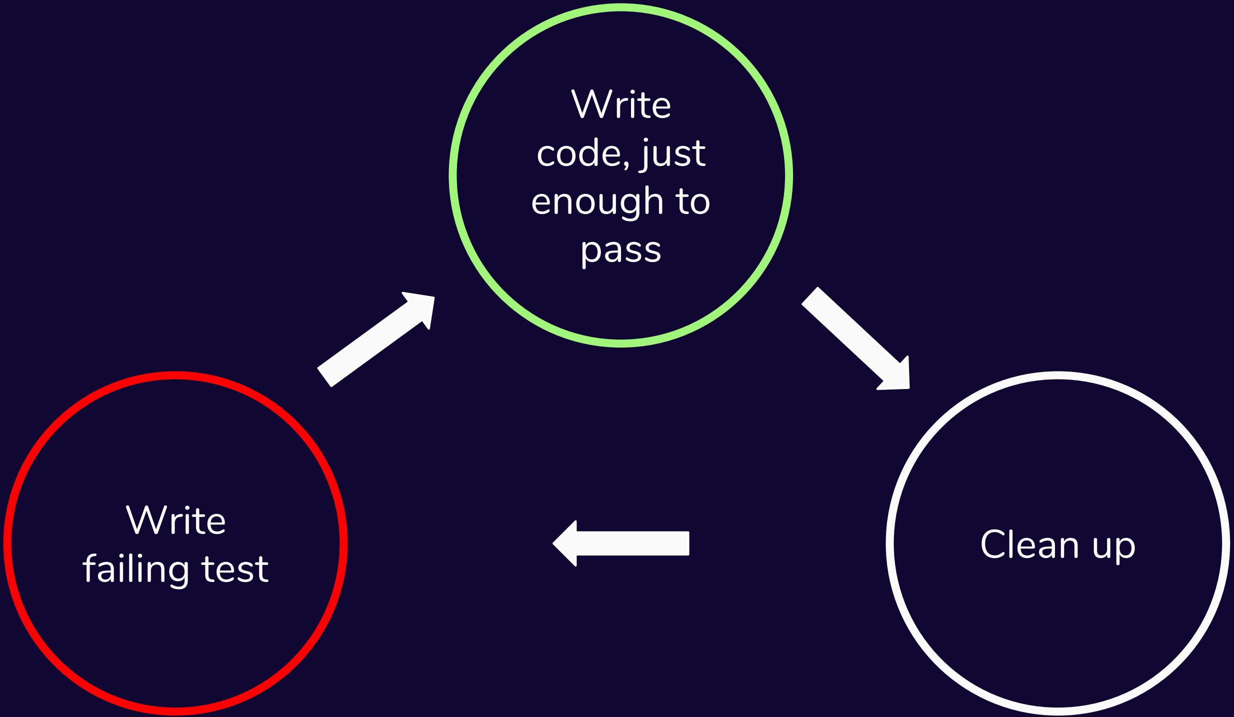
Red - Green - Refactor



Red - Green - Refactor



Red - Green - Refactor



Why do we need tests?

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Why do we need tests?

- Quick feedback about bugs/errors
- Good code design
- Documentation for code behavior
- Confident refactoring

Challenges with TDD

Tools & concepts for writing maintainable tests

Test doubles

Test doubles

Just like stunt doubles

https://people.com/movies/actors-and-their-stunt-doubles-photos

Test doubles - dummies

Test doubles - dummies

- Dummies are like placeholders. Just to fill in parameters.

Test doubles - stubs

Test doubles - stubs

- Objects that return predefined data
- They usually don’t hold state/respond to other actions besides the one they are created for

Test doubles - stubs

```
interface IUserRepository {...}
```

Test doubles - stubs

```kotlin
interface IUserRepository {...}

...

class UserRepository(private val userDao: UserDao) : IUserRepository {

    override fun getUser(userId: Long): User {
        return userDao.findById(userId = userId)
    }
}
```

Test doubles - stubs

```
interface IUserRepository {...}

...

class UserRepositoryStub() : IUserRepository {

    override fun getUser(userId: Long): User {
        return User(userId = 1, email = "sf@sf.com")
    }
}
```

Stub returns a preconfigured user

Test doubles - fakes

Test doubles - fakes

- Similar to stubs, slightly more realistic
- Contain working implementation, but different from real version
- Typically models the behavior of the real class

Test doubles - fakes

```kotlin
interface UserDao {...}
...
class FakeUserDao() : UserDao {

    val users = mutableListOf<User>()

    override fun insert(user: User) {
        users.add(user)
    }

    override fun findById(userId: Long): User {
        return users.find { it.userId == userId }
           ?: throw Exception("user not found")
    }
}
```

Test doubles - fakes

```
interface UserDao {...}
...
class FakeUserDao() : UserDao {

    val users = mutableListOf<User>()

    override fun insert(user: User) {
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        return users.find { it.userId == userId }
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    }
}
```

Fake dao uses a list instead of a db

Test doubles - fakes

```
interface UserDao {...}
...
class FakeUserDao() : UserDao {

    val users = mutableListOf<User>()

    override fun insert(user: User) {
        users.add(user)
    }

    override fun findById(userId: Long): User {
        return users.find { it.userId == userId }
            ?: throw Exception("user not found")
    }
}
```

Fake dao supports the same operations

Test doubles - mocks

Test doubles - mocks

- Objects pre-programmed with expected outputs for given inputs
- Ability to record method calls and verify them
- Throw exceptions if wanted method is not called

Test doubles - mocks

```kotlin
@Test
fun userShouldBeReturnedFromDao() {

    val dao: UserDao = mock()
    whenever(dao.getUser(userId = 5)).thenReturn(User(5, "sf@sf.com"))
    ...

}
```

Test doubles - mocks

```
@Test
fun userShouldBeReturnedFromDao() {

    val dao: UserDao = mock()
    whenever(dao.getUser(userId = 5)).thenReturn(User(5, "sf@sf.com"))
    ...

}
```

Mock pre-programmed with input/output

Test doubles - mocks

```kotlin
// SettingsPresenterTest.kt

@Test
fun clickingIconShouldOpenProfileScreen() {
    ...

    val view: SettingsContract.View = mock()

    val presenter = SettingsPresenter(view, userRepo)
    presenter.profileIconClicked()

    verify(view).openProfileScreen()
}
```

Test doubles - mocks

```kotlin
// SettingsPresenterTest.kt

@Test
fun clickingIconShouldOpenProfileScreen() {
    ...

    val view: SettingsContract.View = mock()

    val presenter = SettingsPresenter(view, userRepo)
    presenter.profileIconClicked()

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```

Ability to verify interactions

What are maintainable tests?

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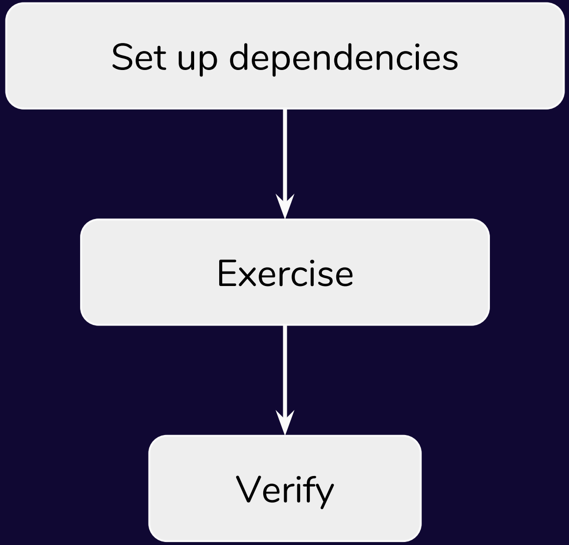
Tests are maintainable when:

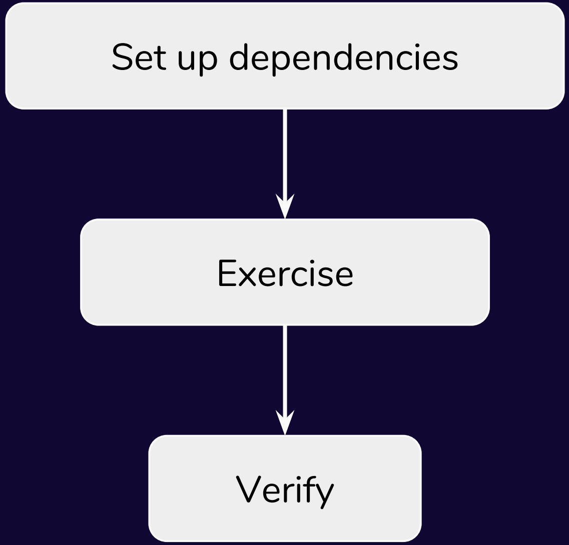
- Old tests do not break often
- Old tests are easy to update
- Easy to add new tests

Writing maintainable tests

1. Use a good test specification system



1. Use a good test specification system



Also known as

Arrange - Act - Assert

Or

Given - When - Then

1. Use a good test specification system

```kotlin
@Test
fun scenarioX() {

    // Given the dependencies/behavior

    // When we act on the scenario

    // Then assert that expected behavior happens

}
```

2. Test behavior, not implementation details

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- For methods that return value, you should care only about the output, not how it was calculated.

2. Test behavior, not implementation details

```
@Test
fun `get user details from cache if available`() {
    ...
    val userRepo = UserRepository(cacheSource, networkSource)

    // given that a user exists in cache
    whenever(cacheSource.getUser(5)).thenReturn(User(5, "sf@sf.com"))

    // when we get user from repository
    val user = userRepo.getUser(userId = 5)

    // then verify that the cache source was called
    verify(cacheSource).getUser(5)
}
```

2. Test behavior, not implementation details

```kotlin
@Test
fun `get user details from cache if available`() {
    ...
    val userRepo = UserRepository(cacheSource, networkSource)

    // given that a user exists in cache
    whenever(cacheSource.getUser(5)).thenReturn(User(5, "sf@sf.com"))

    // when we get user from repository
    val user = userRepo.getUser(userId = 5)

    // then verify that the cache source was called
    verify(cacheSource).getUser(5)
}
```

This tests implementation details

2. Test behavior, not implementation details

```kotlin
@Test
fun `get user details from cache if available`() {
    ...
    // given that a user exists in cache
    val cachedUser = User(5, "sf@sf.com")
    whenever(cacheSource.getUser(5)).thenReturn(cachedUser)

    // when we get user from repository
    val returnedUser = userRepo.getUser(userId = 5)

    // then verify that the returned user is the one from cache
    assertEquals(cachedUser, returnedUser)
}
```

2. Test behavior, not implementation details

```kotlin
@Test
fun `get user details from cache if available`() {
    ...
    // given that a user exists in cache
    val cachedUser = User(5, "sf@sf.com")
    whenever(cacheSource.getUser(5)).thenReturn(cachedUser)

    // when we get user from repository
    val returnedUser = userRepo.getUser(user

    // then verify that the returned user is the one from cache
    assertEquals(cachedUser, returnedUser)
}
```

This tests general behavior of this repository in this scenario.

2. Test behavior, not implementation details

- For methods that return value, one should care only about the output, not how it was calculated.
- For methods that do not return any value, verify interactions with dependencies

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- For methods that return value, one should care only about the output, not how it was calculated.
- For methods that do not return any value, verify interactions with dependencies
- Be careful about overusing mocks.

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In most cases, only one assert / verify should be done in each test.

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A test should fail for only 1 reason

3. Assert/verify only one thing per test

```
@Test
fun `enabling setting updates preference and sends tracking`() {
  ...
  // when user enables the setting
  viewModel.enableSetting()

  // then verify that we set preference
  verify(userPreference).enableSetting()

  // then verify that we send tracking
  verify(trackingUtils).trackUserEnabledSetting()
}
```

3. Assert/verify only one thing per test

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@Test
fun `enabling setting updates preference and sends tracking`() {
   ...
   // when user enables the setting
   viewModel.enableSetting()

   // then verify that we set preference
   verify(userPreference).enableSetting()

   // then verify that we send tracking
   verify(trackingUtils).trackUserEnabledSetting()
}
```

The use of “and” suggests that the test is testing more than one thing

3. Assert/verify only one thing per test

```kotlin
@Test
fun `enabling setting updates preference`() {
    ...
    // then verify that we set preference
    verify(userPreference).enableSetting()
}

@Test
fun `enabling setting posts tracking`() {
    ...
    // then verify that we post tracking
    verify(trackingUtils).trackUserEnabledSetting()
}
```

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From the test name, we should be able to tell why the test failed.

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fun `search field is updated correctly when user has search history`() {
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fun `search field is updated correctly when user has search history`() {
    ...
}
```

🙄

4. Use descriptive test names

From the test name, we should be able to tell why the test failed.

```kotlin
@Test
fun `search field is updated correctly when user has search history`() {
    ...
}


@Test
fun `search field is updated with last search when user has search history`() {
    ...
}
```

4. Use descriptive test names

From the test name, we should be able to tell why the test failed.

```
@Test
fun `search field is updated correctly when user has search history`() {
    ...
}
```

```
@Test
fun `search field is updated with last search when user has search history`() {
    ...
}
```

😊

4. Use descriptive test names

Kotlin allows us to use to write test function names with spaces

```kotlin
@Test
fun `welcome dialog should be shown on first log in`() {
    // test goes here
}
```

4. Use descriptive test names

JUnit 5 allows to specify a custom display name for the test

```
@Test
@DisplayName("welcome dialog should be shown on first log in")
void showWelcomeDialogOnFirstLogin() {
    // test goes here
}
```

5. More tips

- Avoid logic in your tests -> if/else, loops, etc.
- Avoid abstractions in tests
- Be generous with comments
- Use parameterized tests

Resources

- https://martinfowler.com/articles/mocksArentStubs.html
- http://xunitpatterns.com/
- https://testing.googleblog.com/search/label/TotT
- https://mtlynch.io/good-developers-bad-tests/
- https://jeroenmols.com/blog/2018/12/06/fixthetest/

Thank you!

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