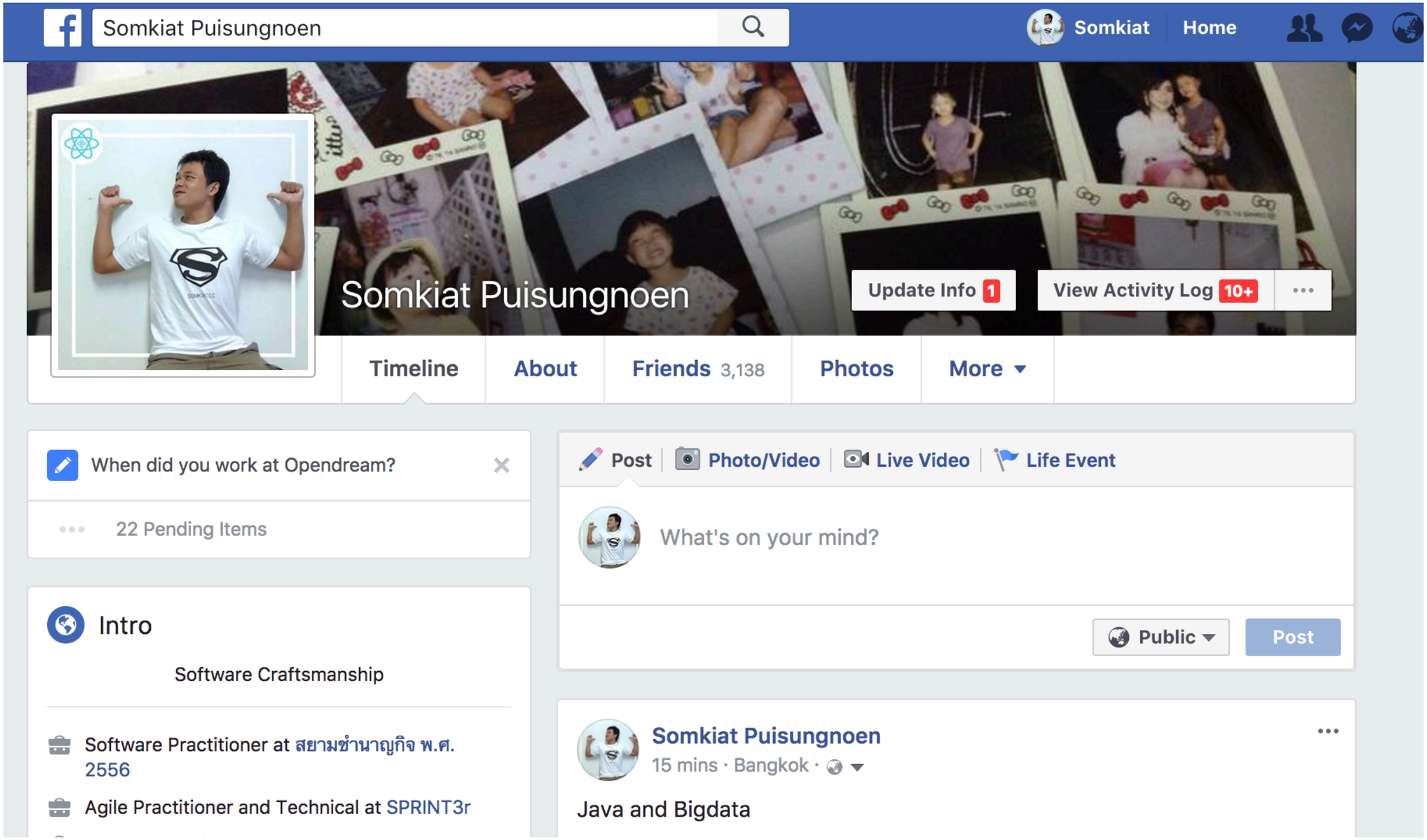
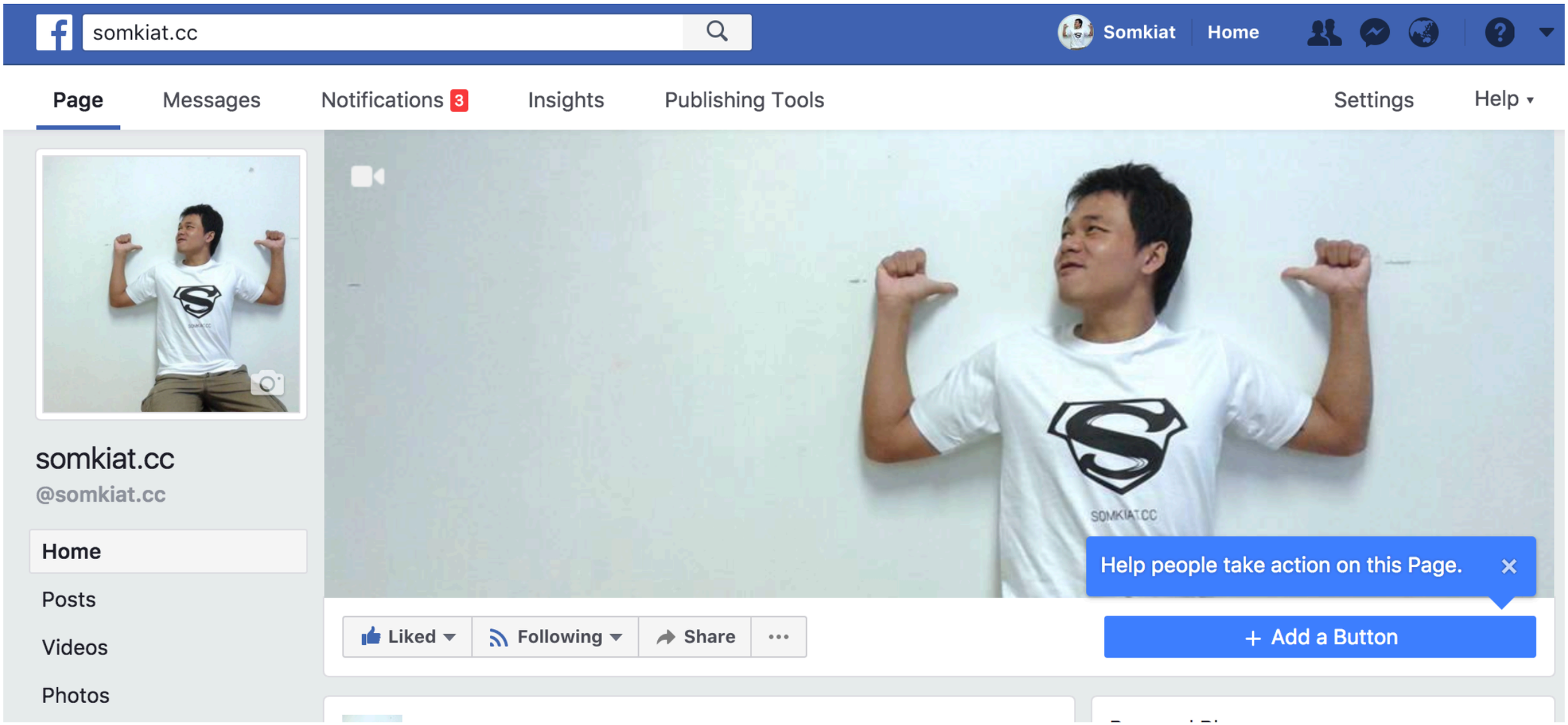
สยามชำนาญกิจ
SIAM CHAMNAN KIT

Test-Driven Development with JAVA





Slide

https://github.com/up1/course-tdd-with-java-2020

Testing in general

Technical excellence

https://less.works/less/technical-excellence/index

SPECIFICATION BY EXAMPLE

CONTINUOUS INTEGRATION

CONTINUOUS DELIVERY

TEST AUTOMATION

ACCEPTANCE TESTING

TECHNICAL EXCELLENCE

ARCHITECTURE & DESIGN

CLEAN CODE

THINKING ABOUT TESTING

TEST-DRIVEN DEVELOPMENT

UNIT TESTING

SPECIFICATION BY EXAMPLE

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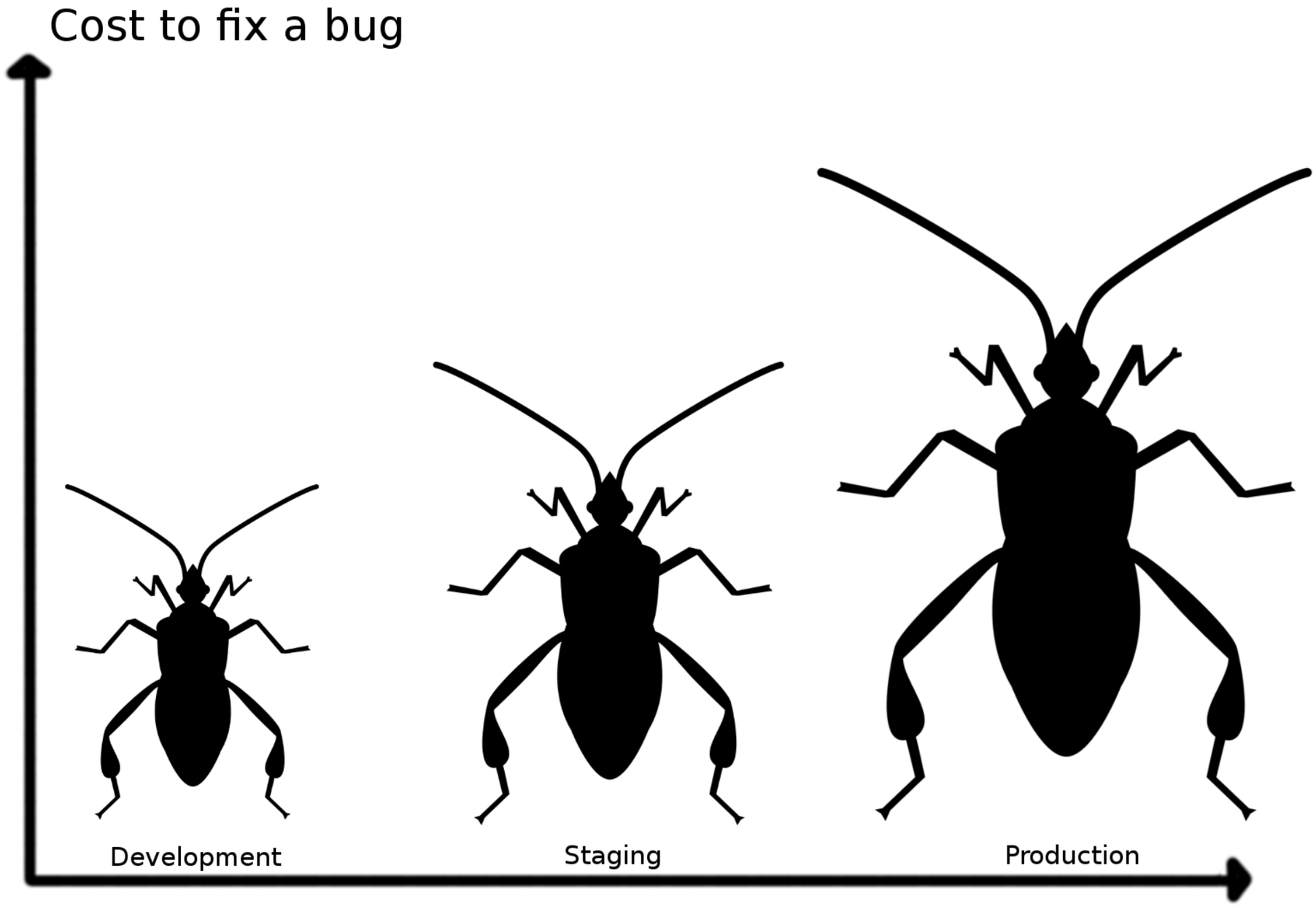
TEST-DRIVEN DEVELOPMENT

UNIT TESTING

"Program testing can be used to show the presence of bugs, but never their absence."

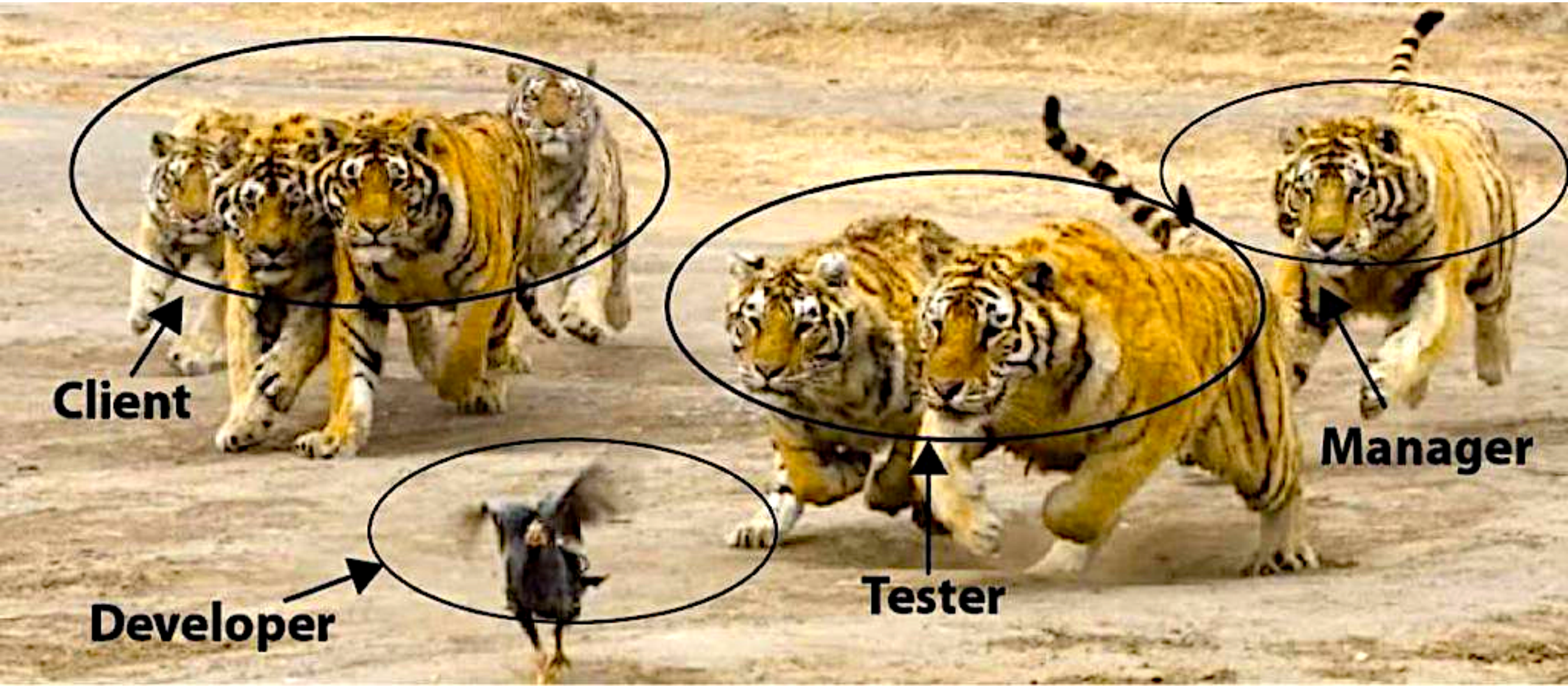
Edsger W. Dijkstra, 1970, Notes on Structured Programming

Start with Why …



DDD

Deadline Driven Development



Developer vs Tester

6

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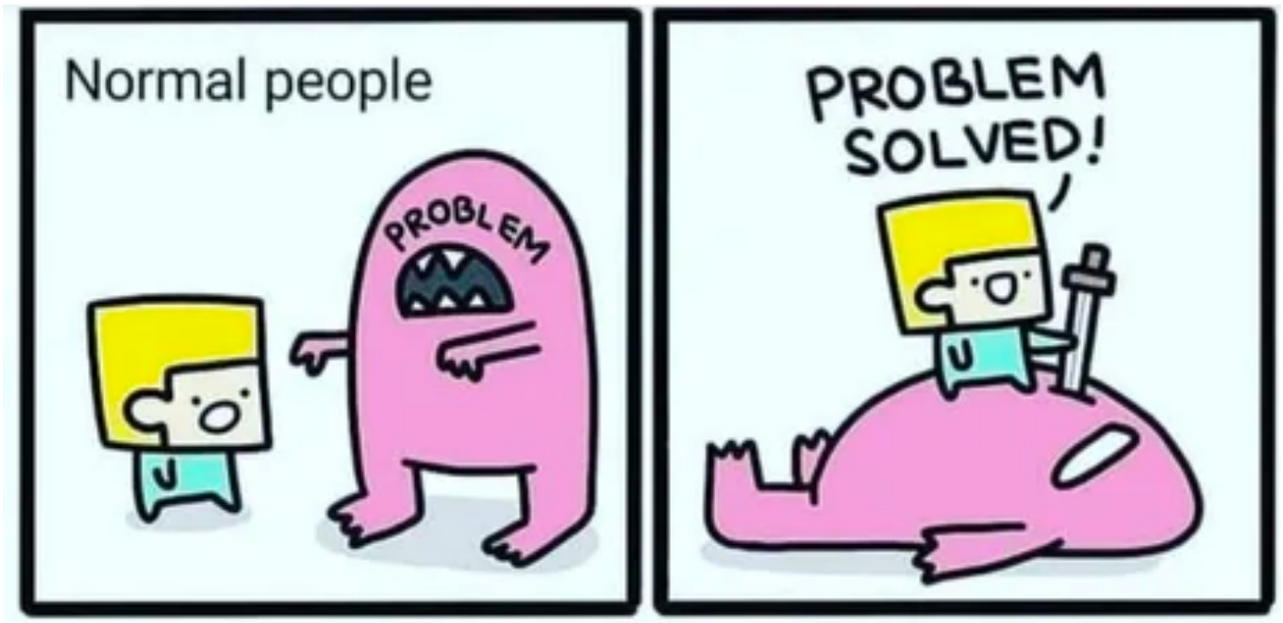
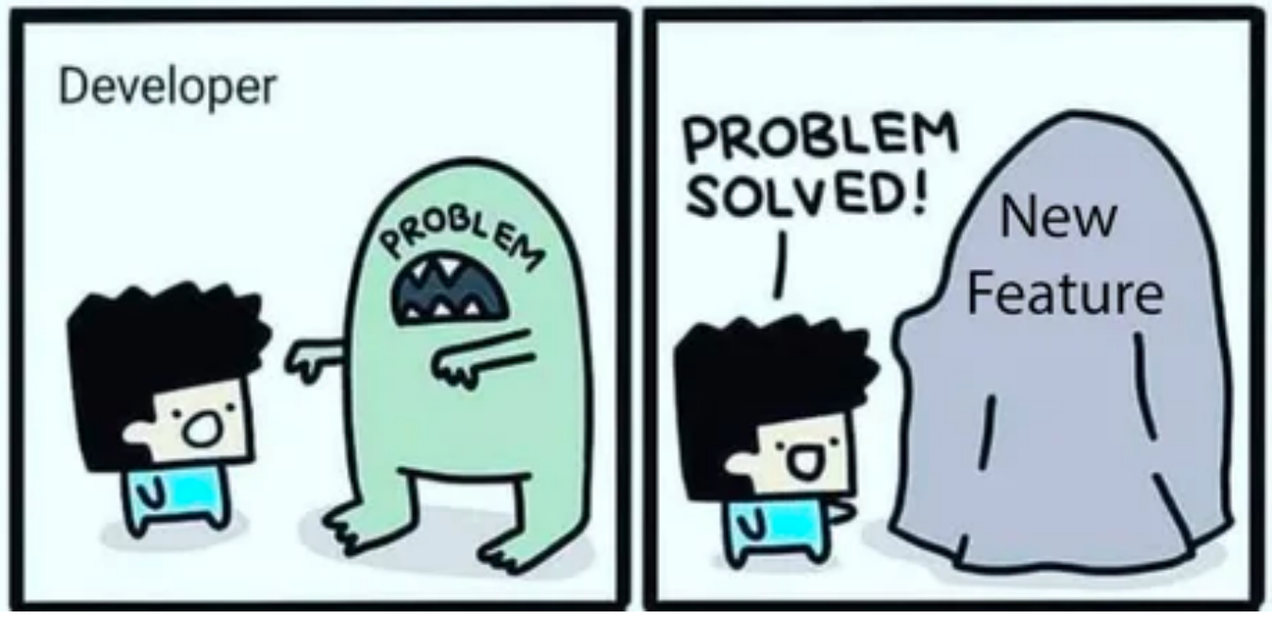




Every time a developer changing the code !!

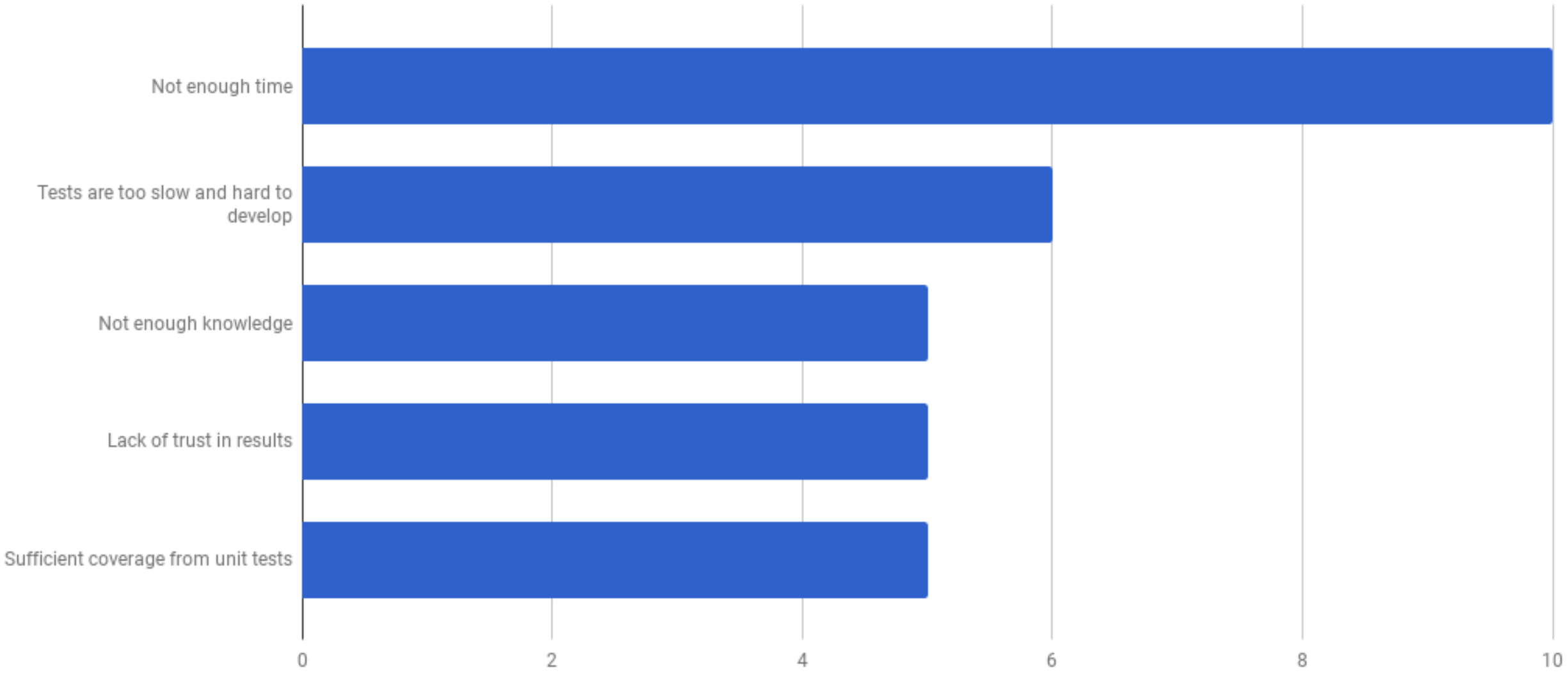
Why we need to test ?

Help you to **catch bugs**
Boosted confidence
Quality code
Enforce **modularity** of your project
Develop features **faster**
Better documentation

But,

It's take time to learning and practice !!

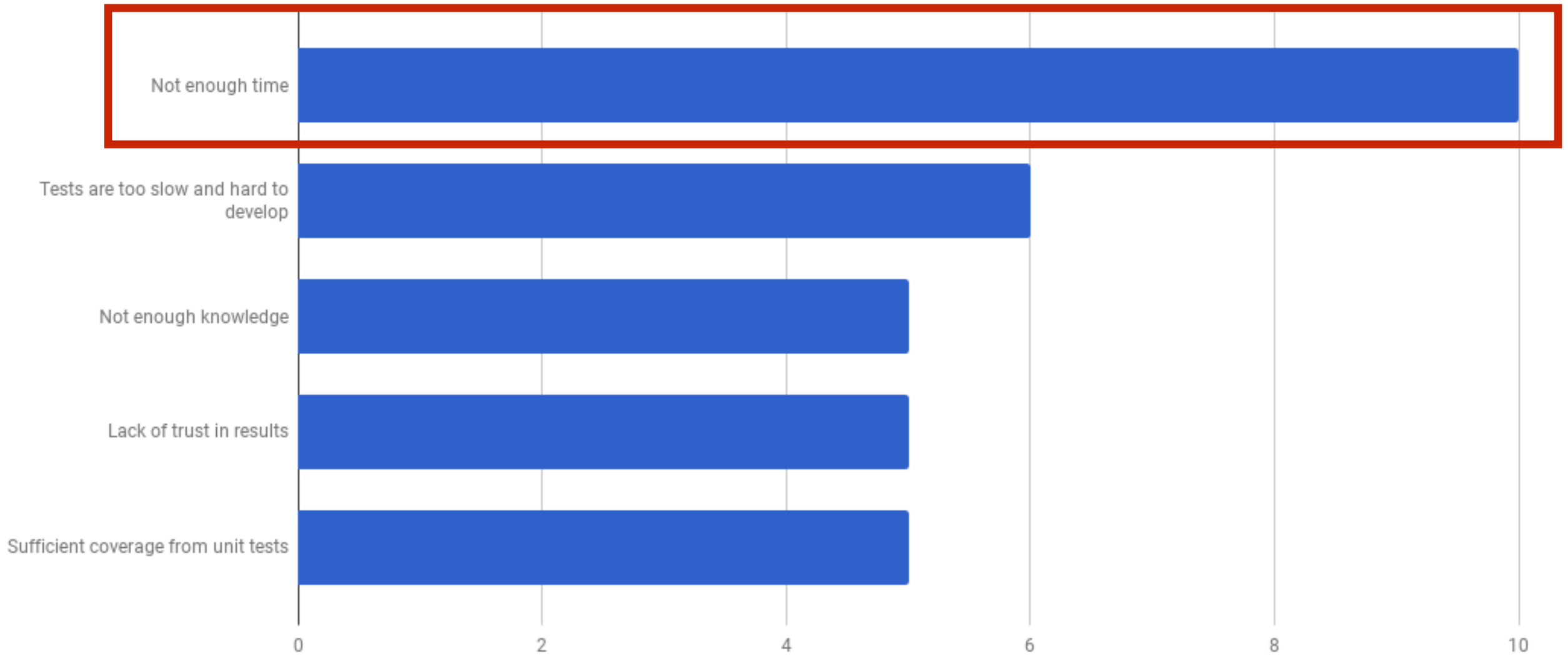
Why not write automated tests ?



https://slack.engineering/android-ui-automation-part-1-building-trust-de3deb1c5995

Why not write automated tests ?

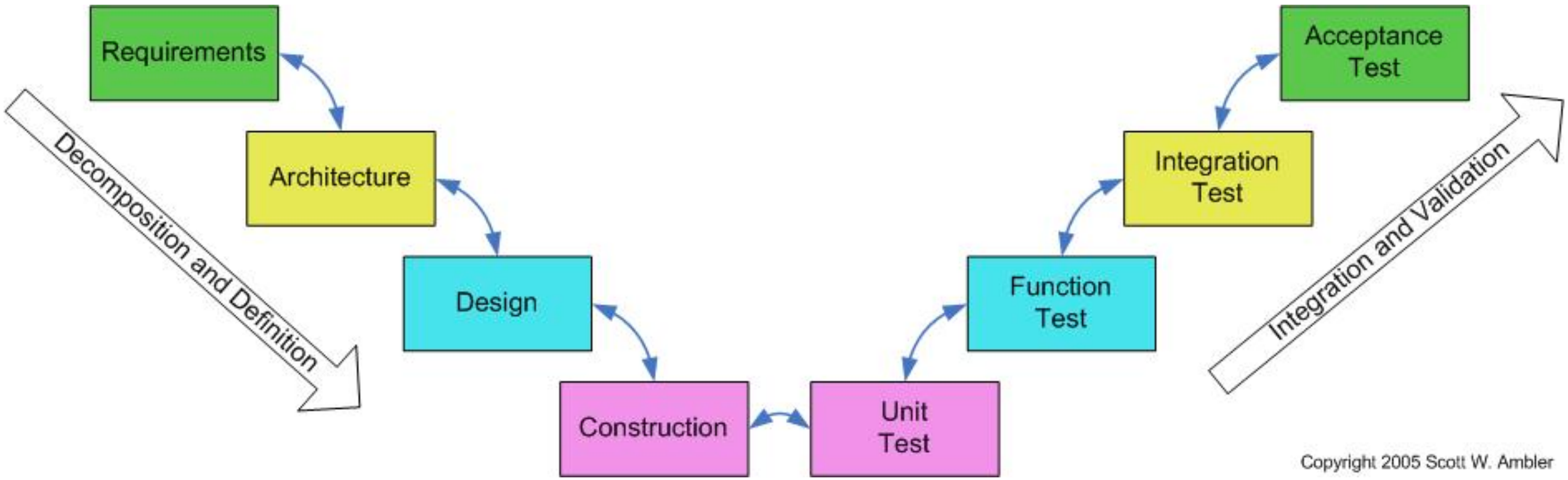
Not enough time !!!



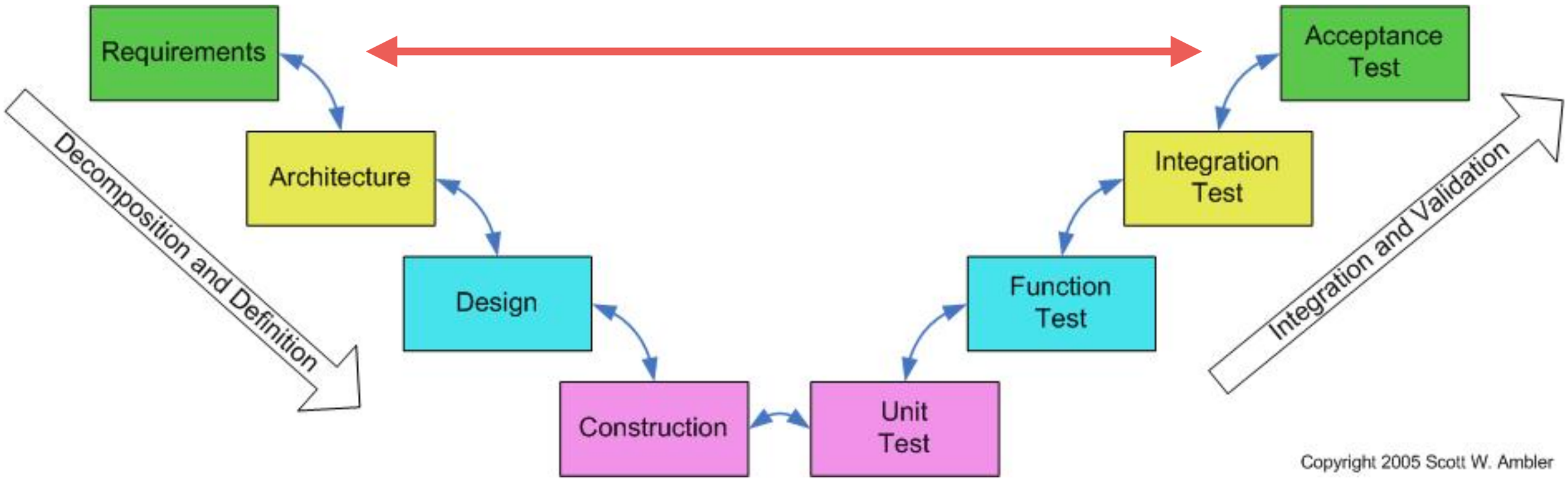
https://slack.engineering/android-ui-automation-part-1-building-trust-de3deb1c5995

What kind of test should we write ?

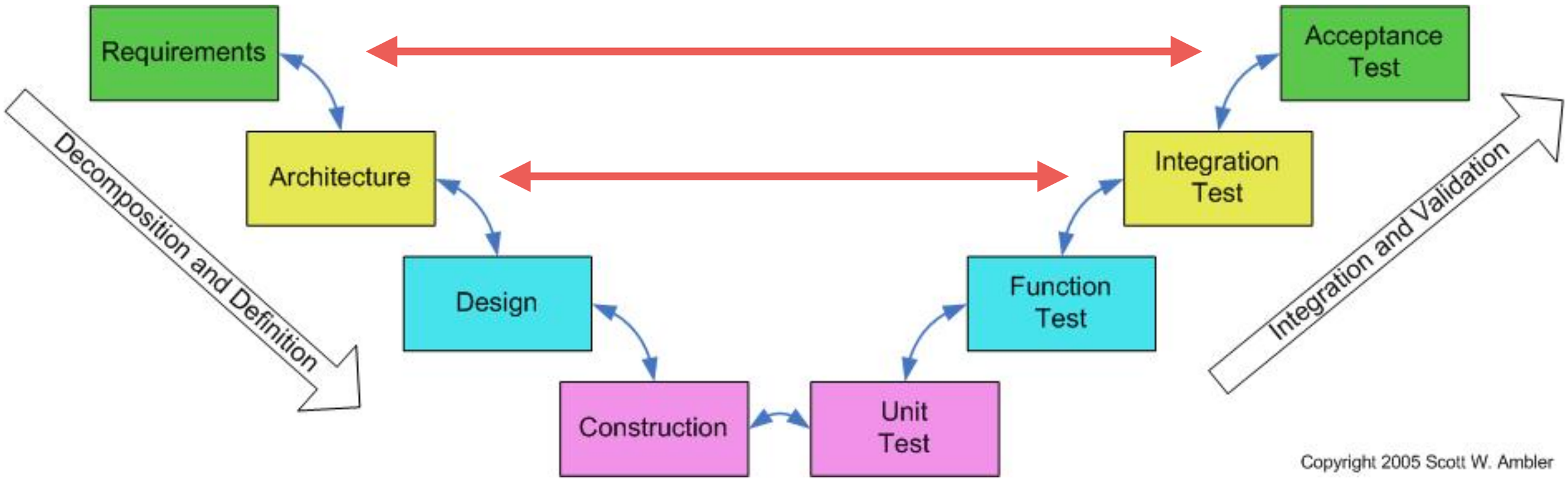
V Model



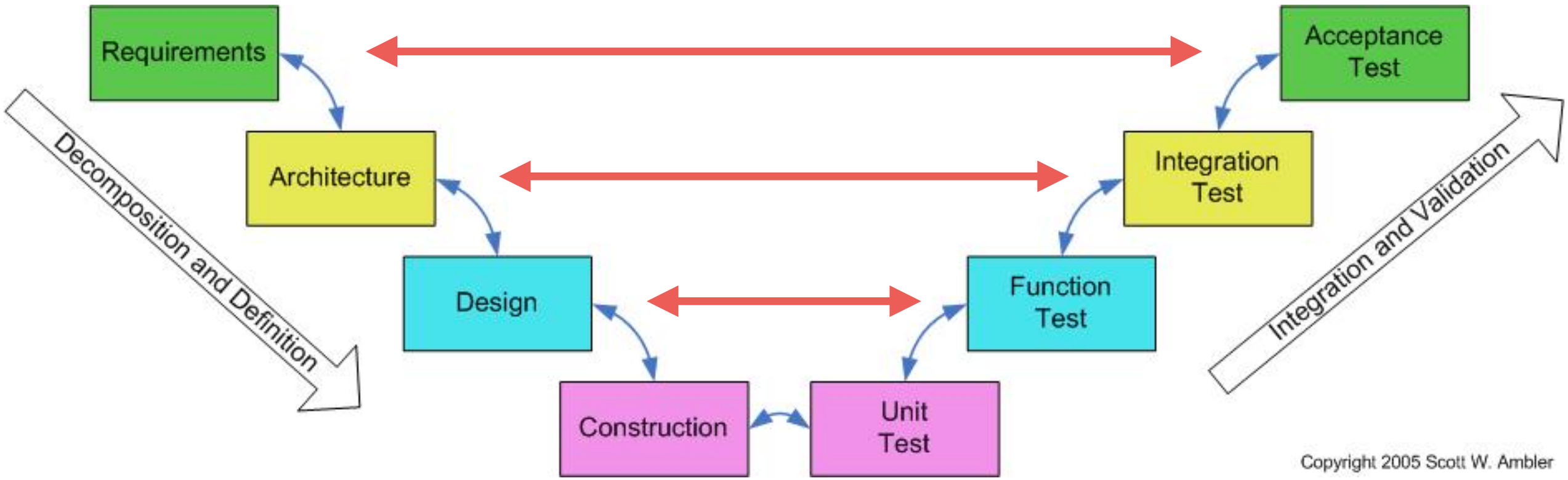
V Model



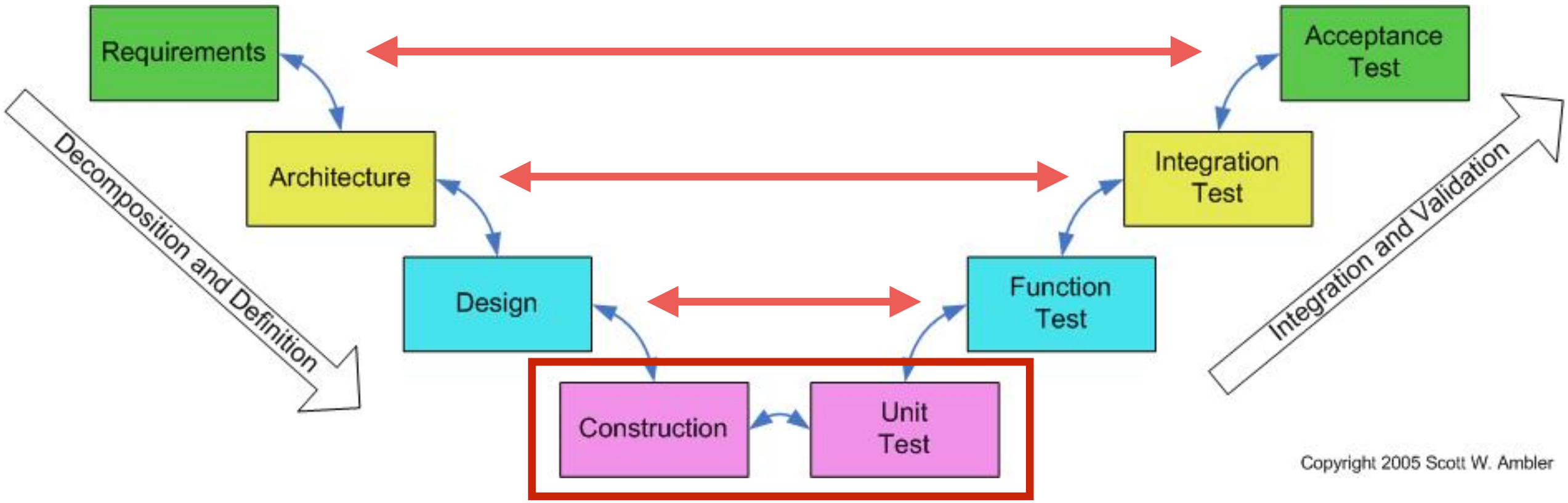
V Model



V Model

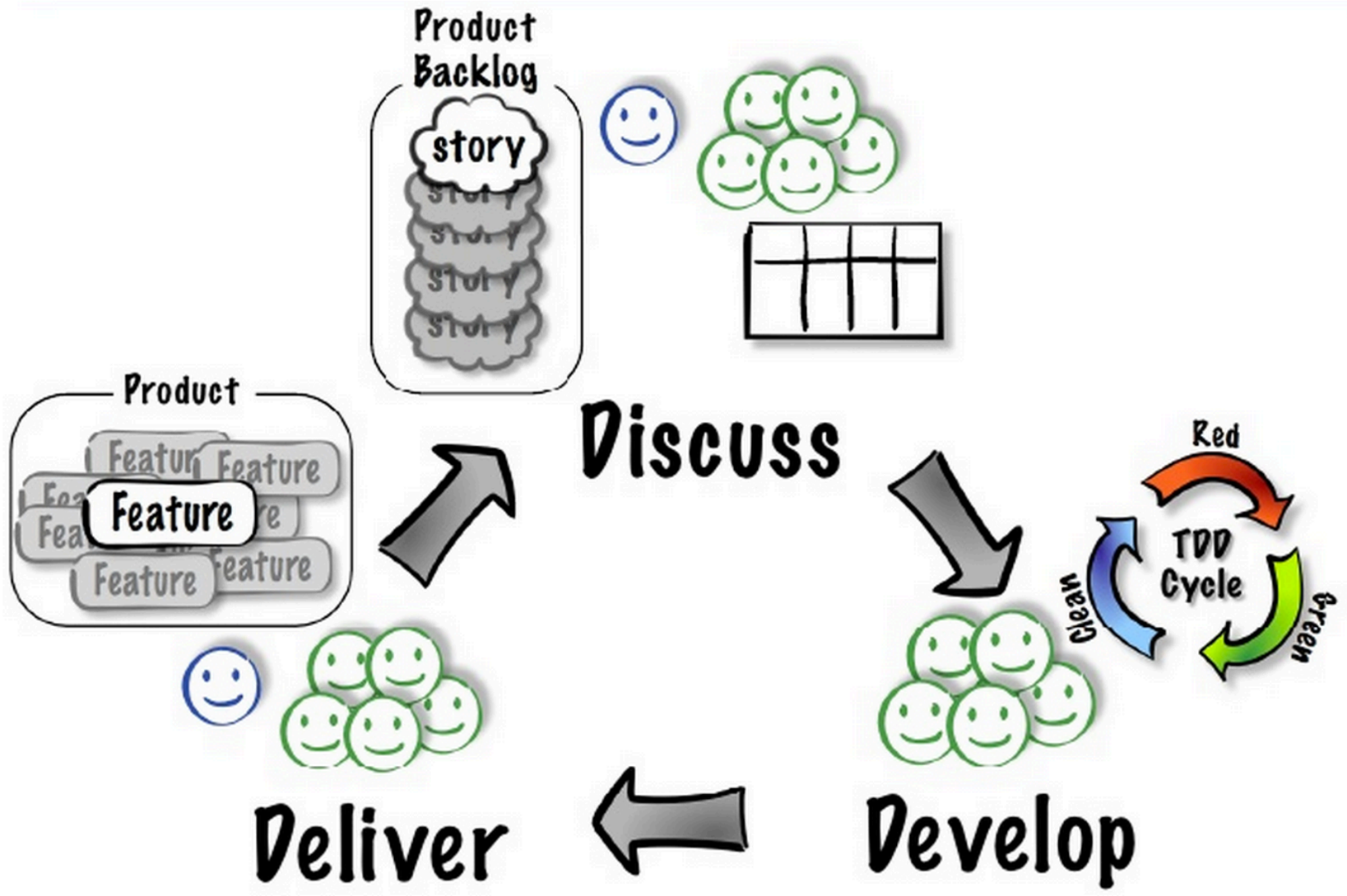


V Model



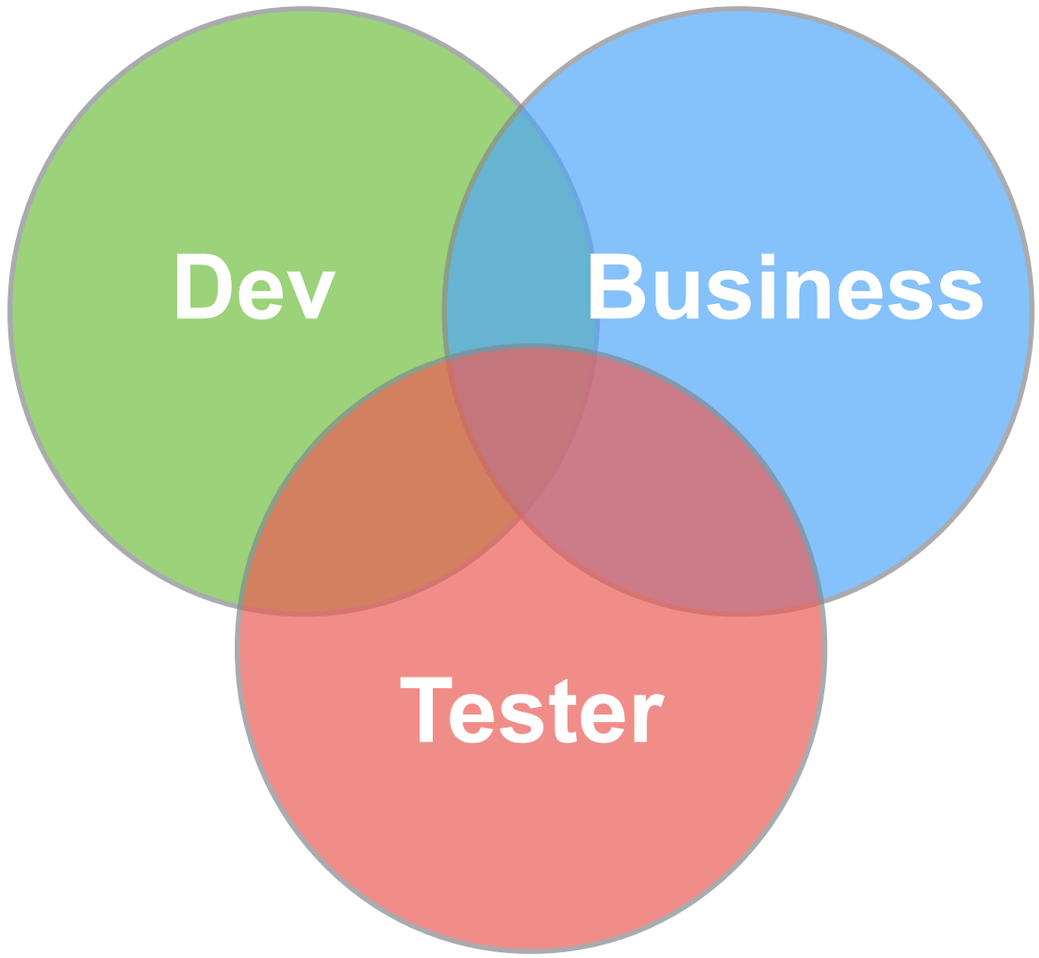
THINK before coding

Acceptance Test-Driven Development



(Model developed with Pekka Klärck, Bas Vodde, and Craig Larman.)

Acceptance Test-Driven Development



Acceptance Tests

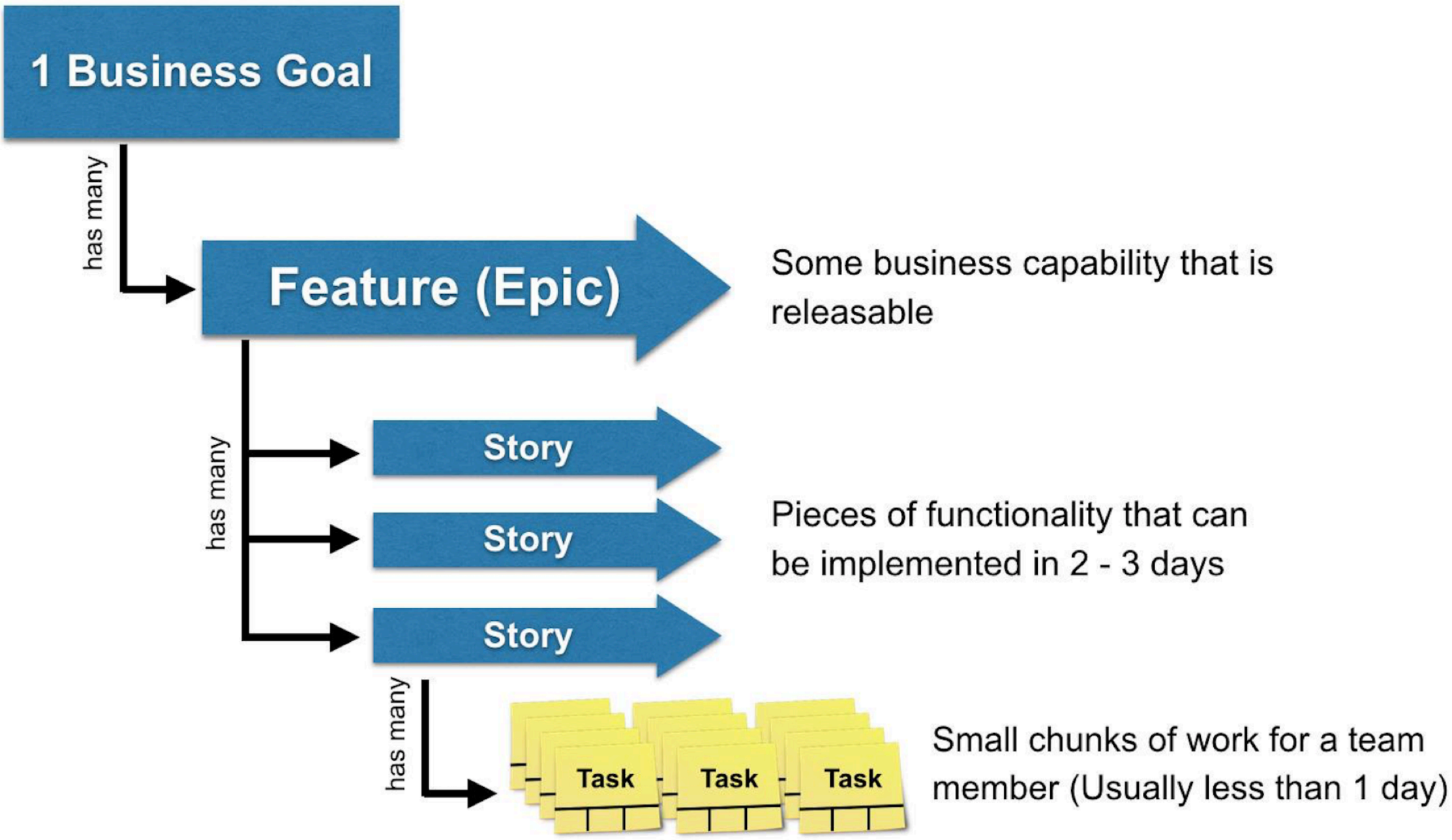
=

Business Criteria

+

Examples (data)

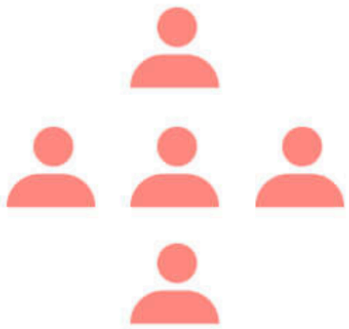
Work break down



Whole team approach

Functional

Common functional expertise



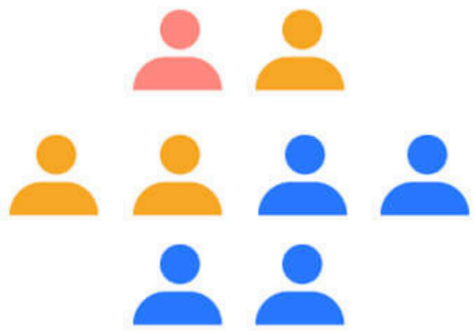
System analysts

Developers

Testers

Cross - Functional

Representatives from the various functions

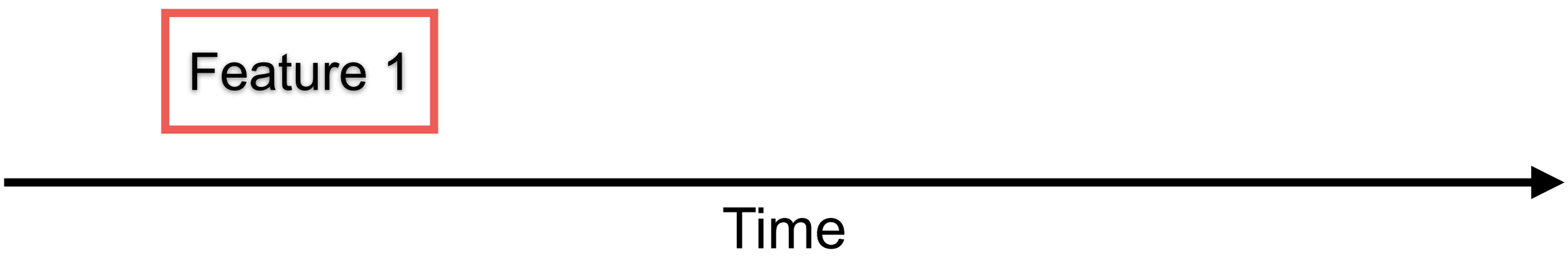


Development Team

Key success factors

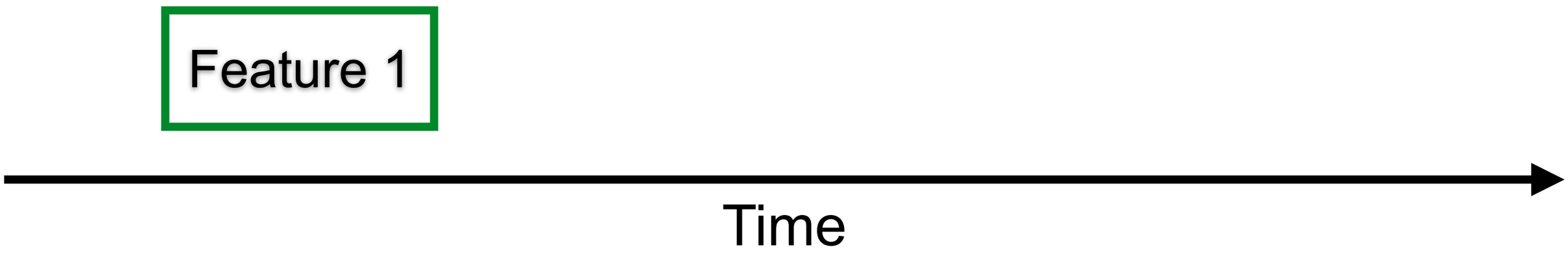
Whole team solve problems
Whole team thinks about **testing**
Whole team **committed to quality**
Everyone **collaborates**

Iterative and incremental process



Iterative and incremental process

Done = coded and tested



Iterative and incremental process

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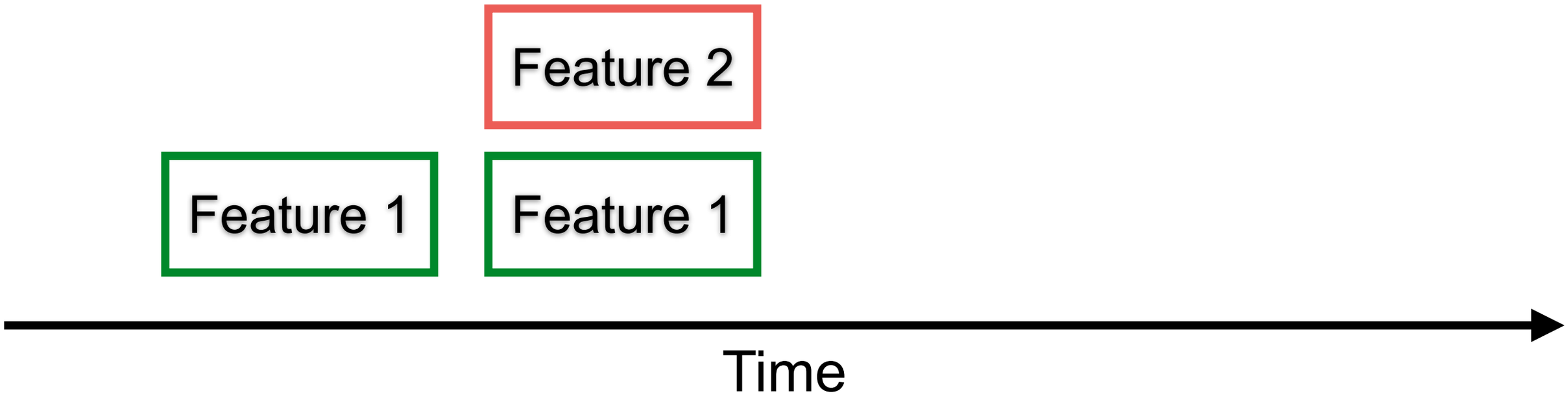

Iterative and incremental process

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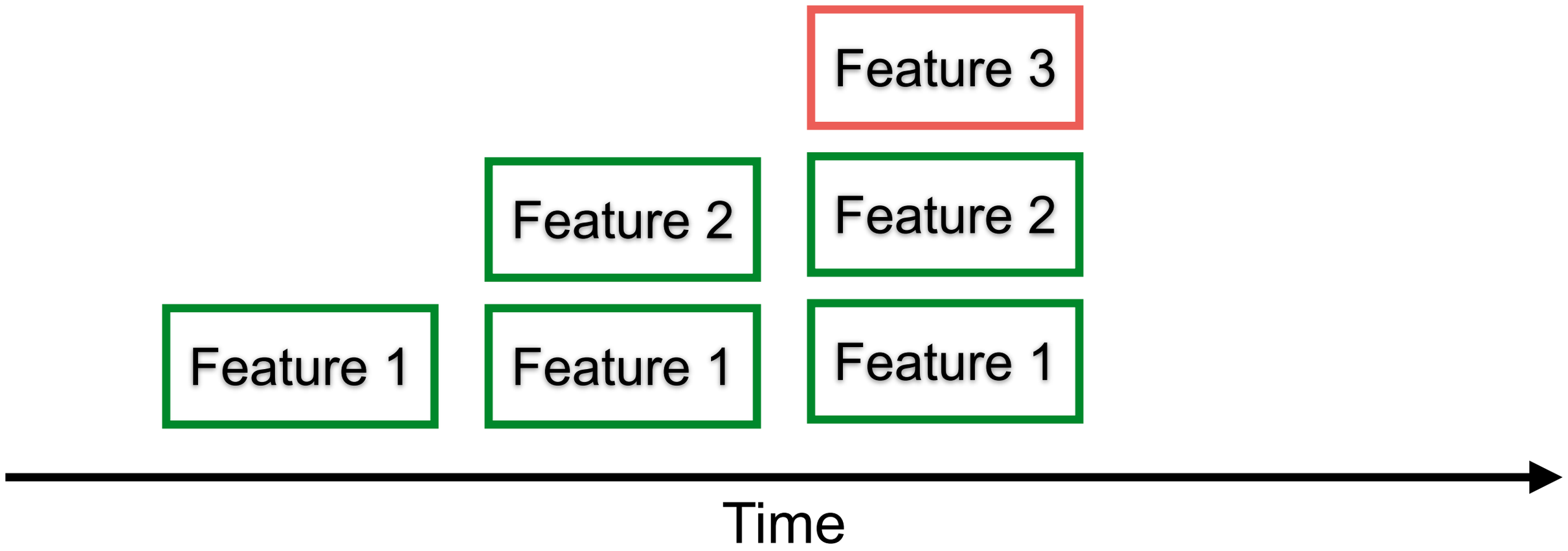

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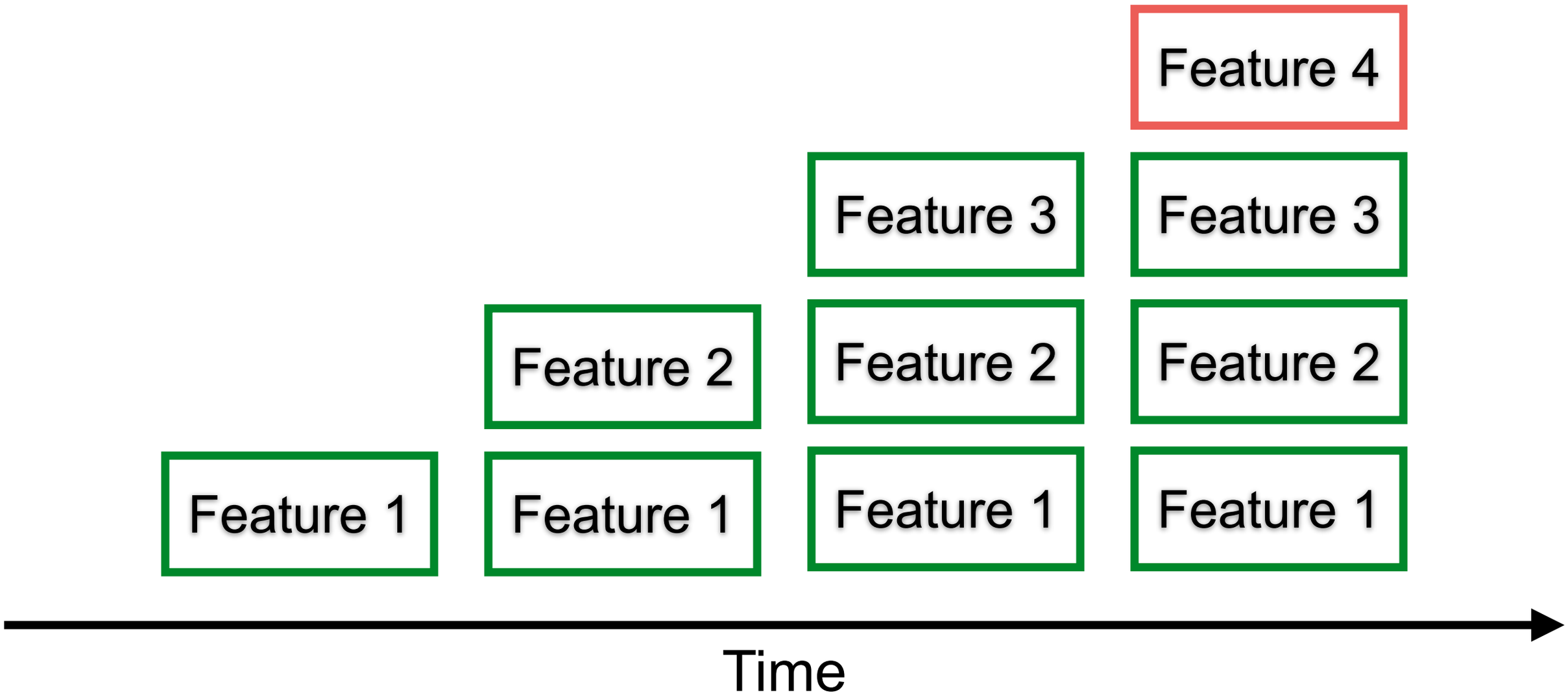

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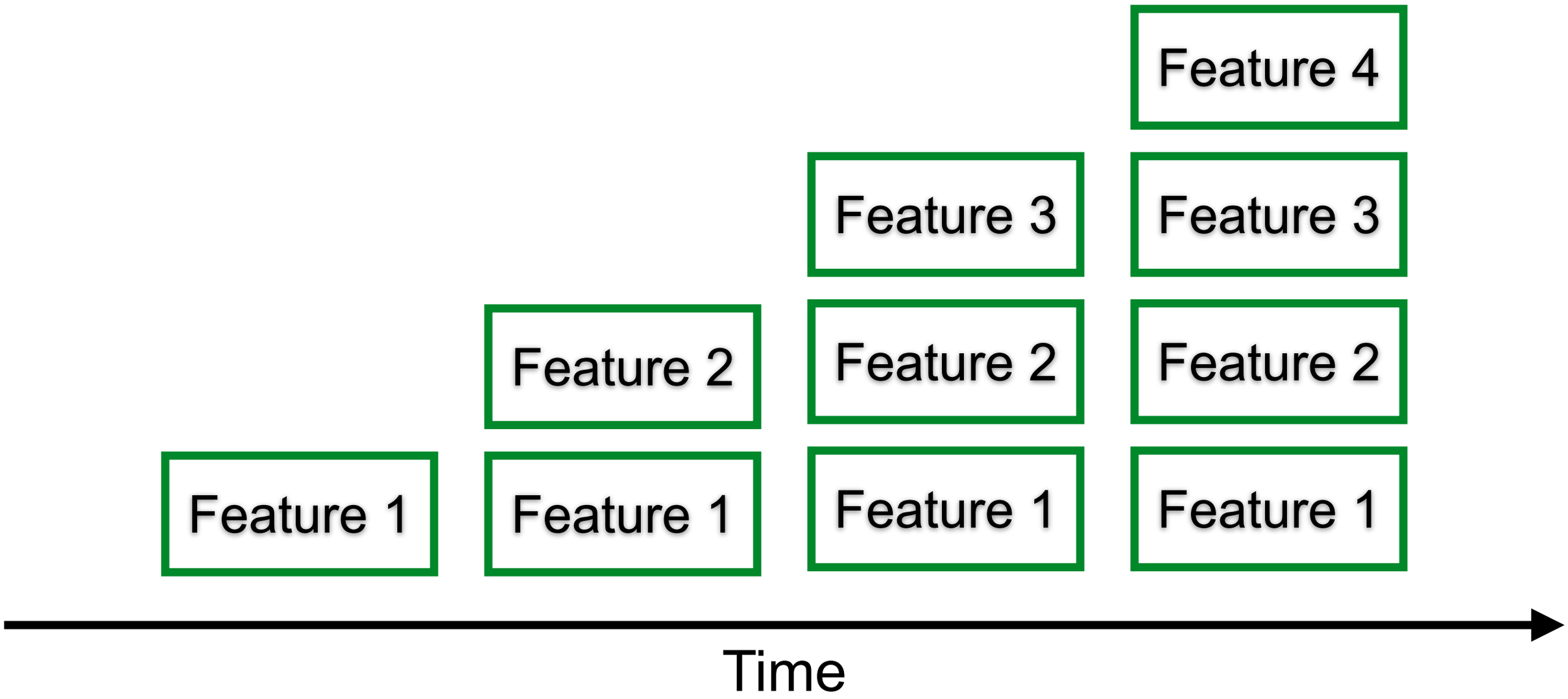


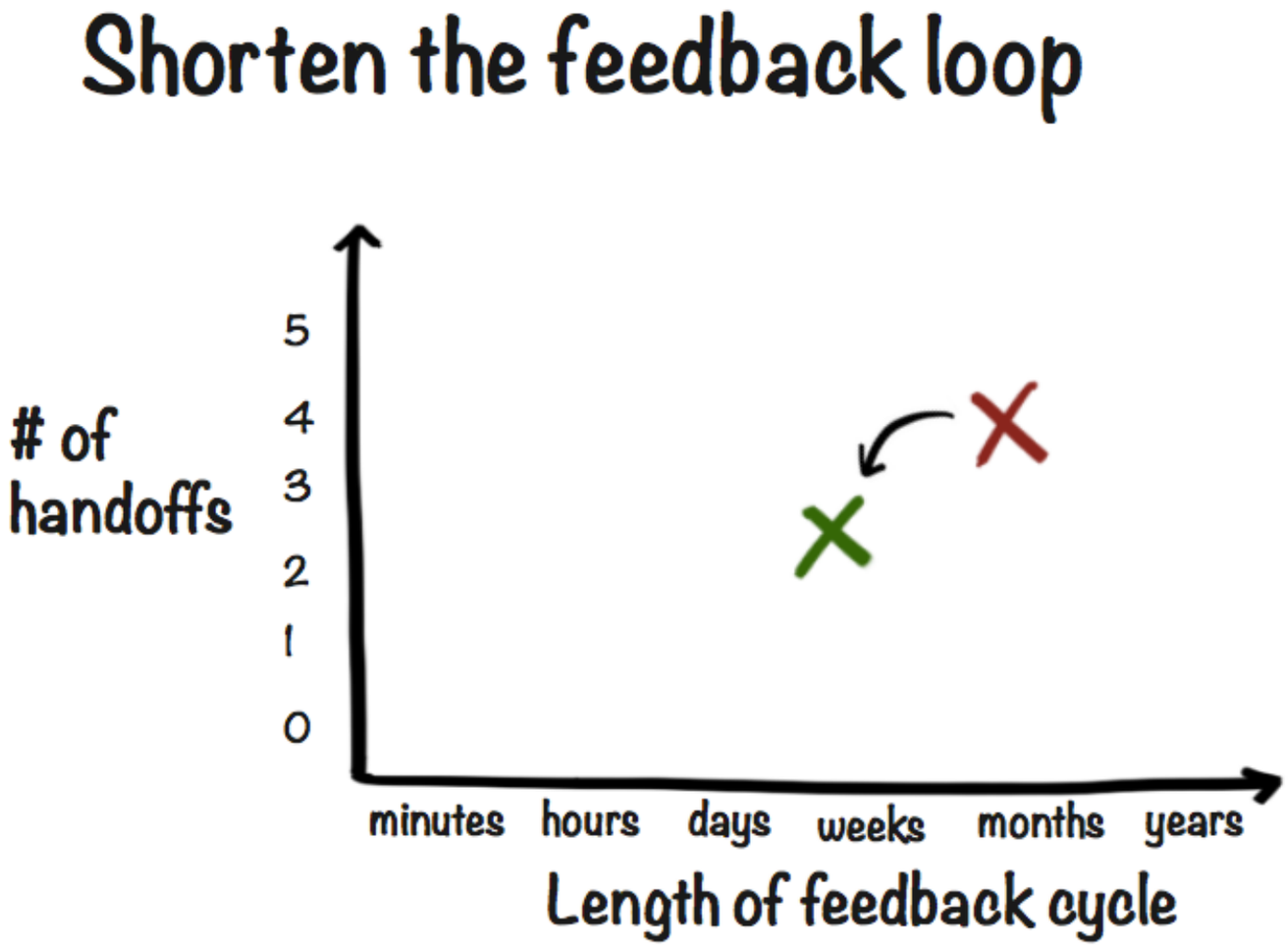
Testing is activity

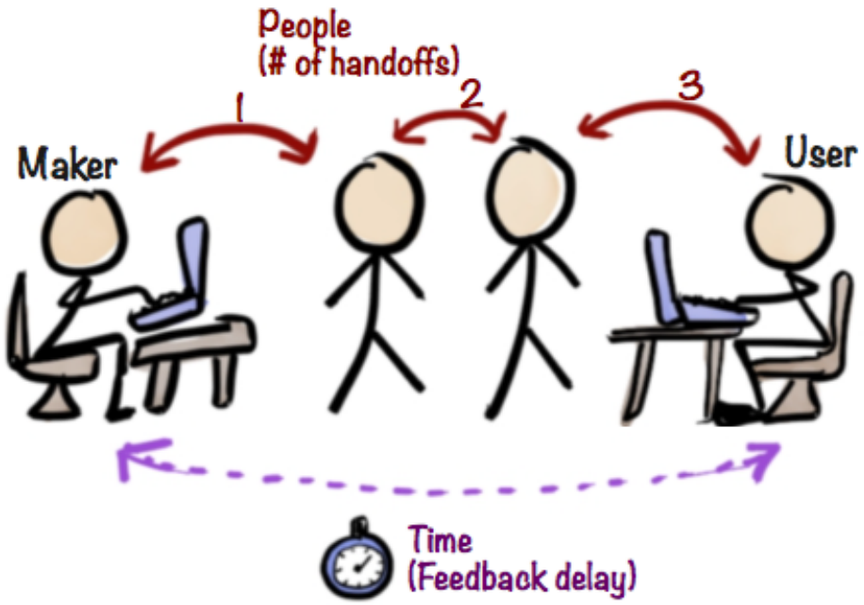
~~Test phase~~

~~Test team~~

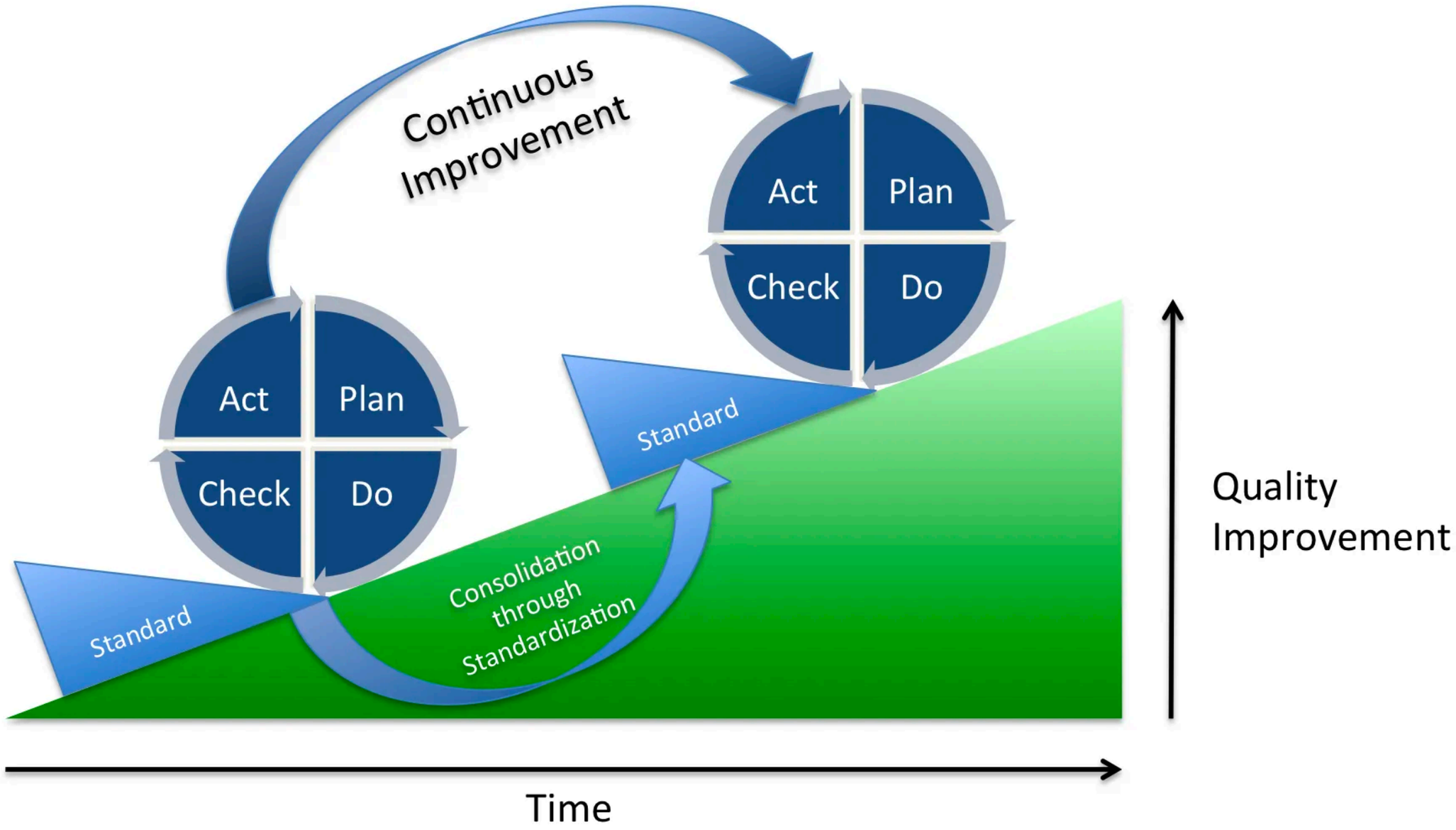
~~Tester role~~

Fast feedback loop

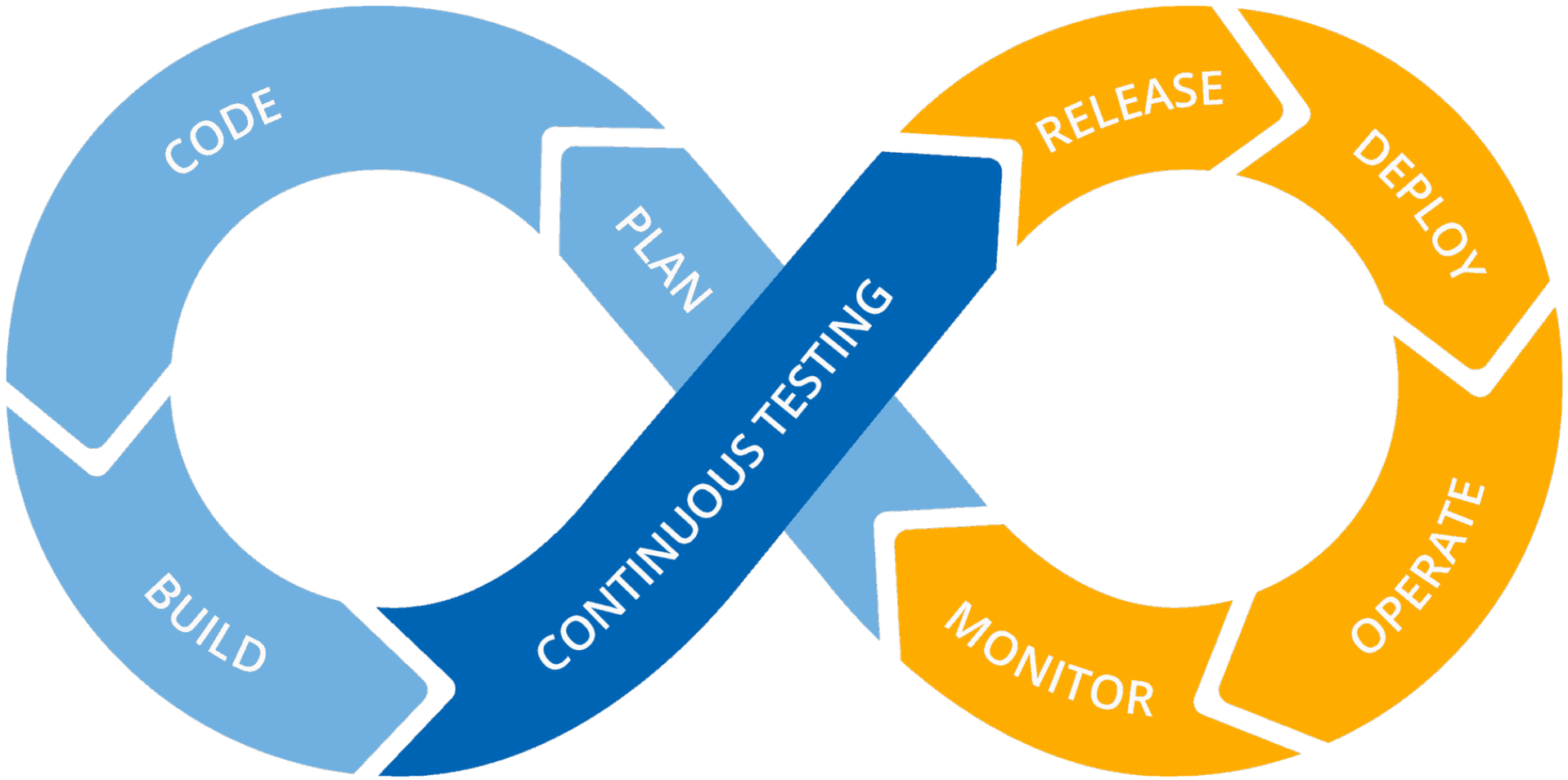




Continuous improvement



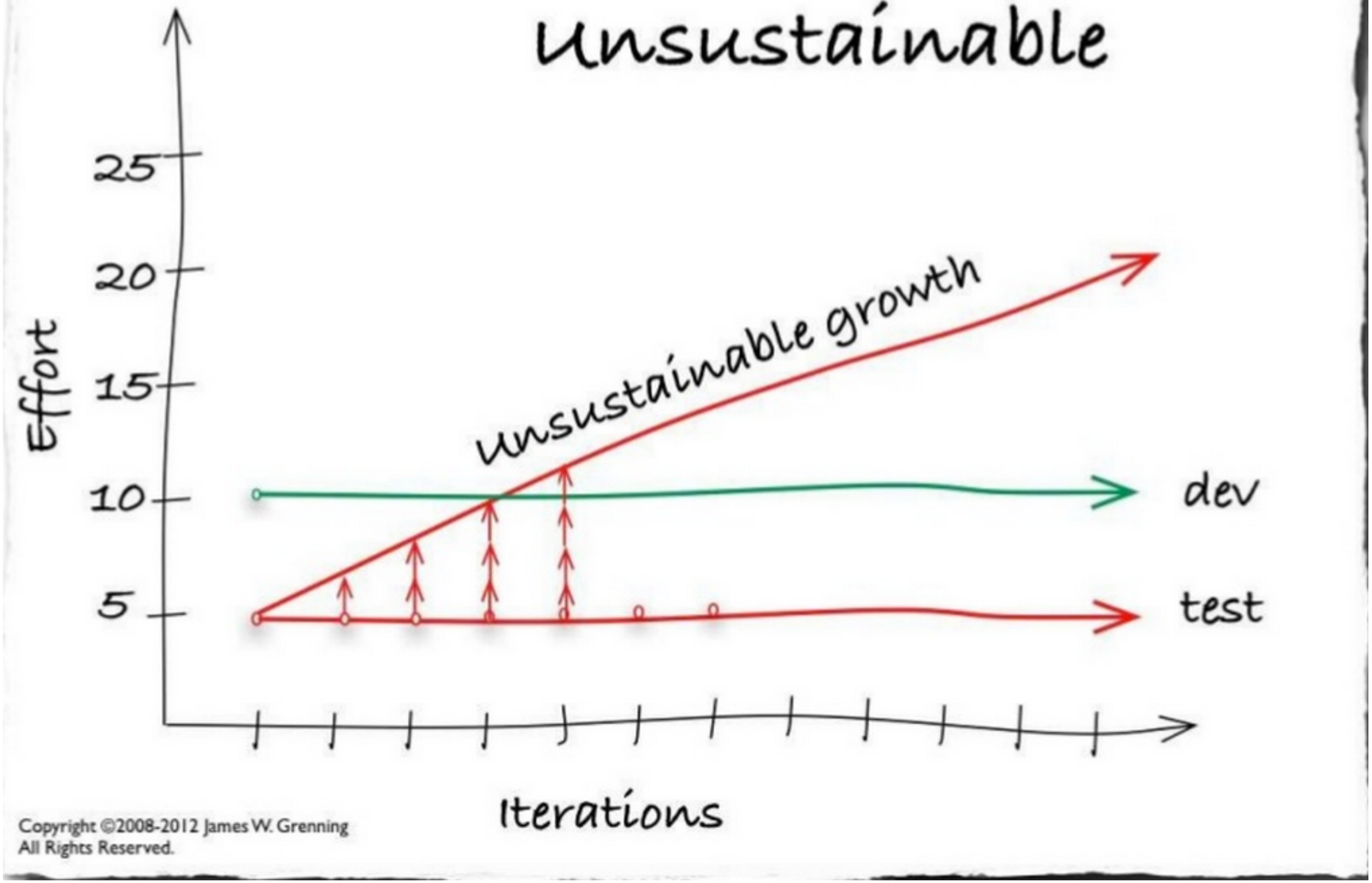
Continuous testing



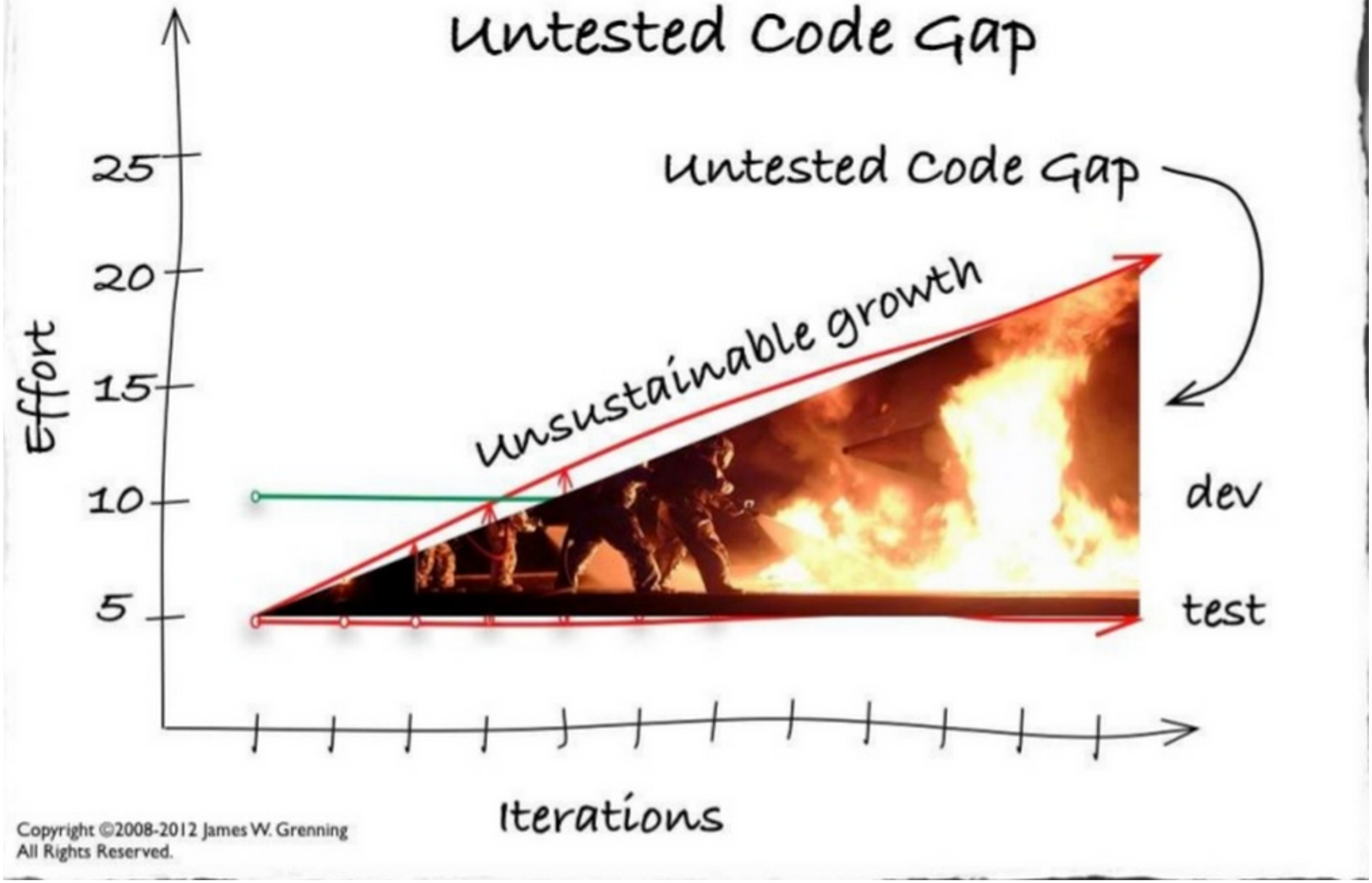
But …

Manual testing ?

Manual Test is Unsustainable



Risk Accumulates in the Untested Code Gap



We need automation !!

Why should you automate ?

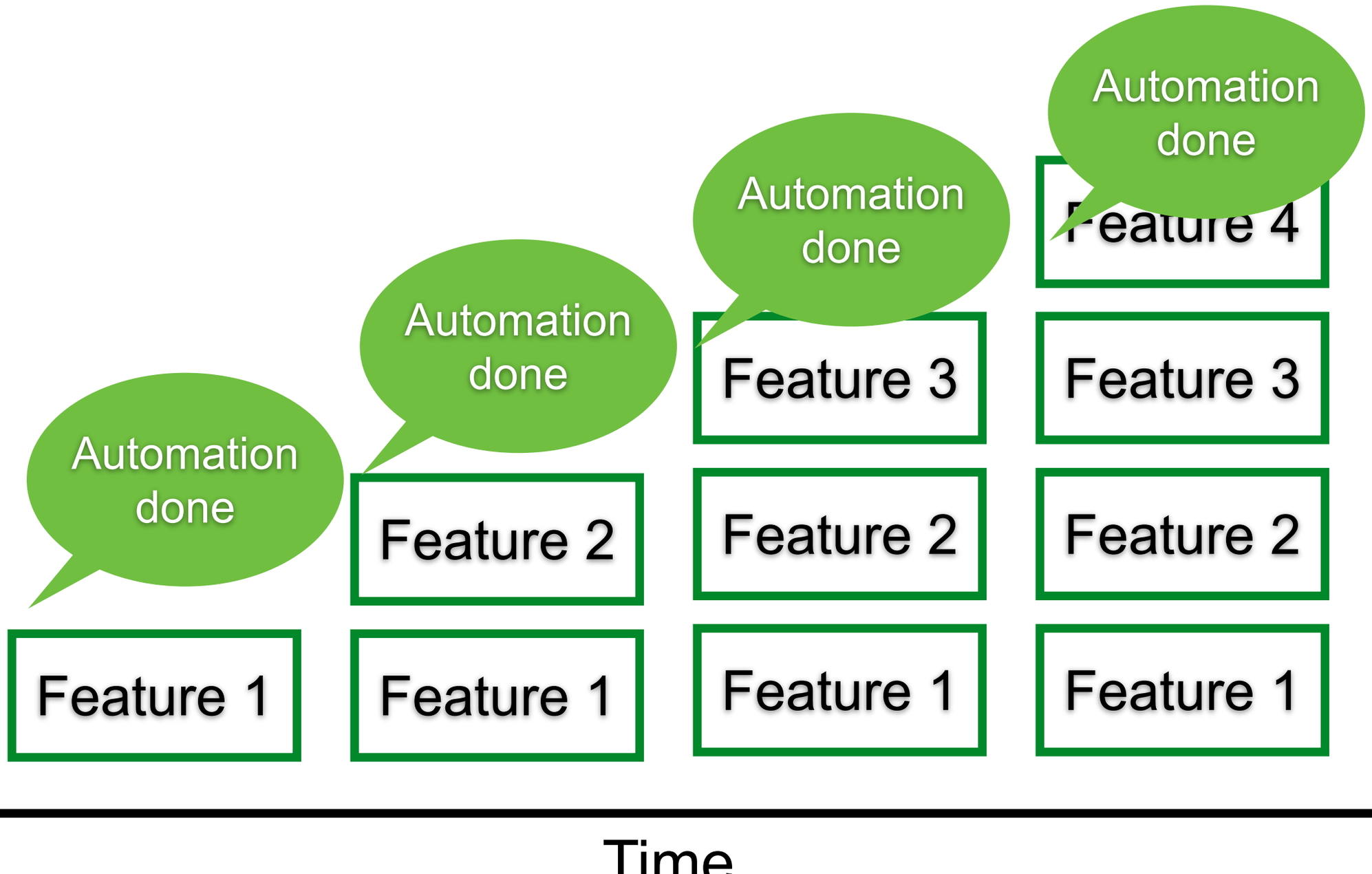
Manual checking take too long
Manual checks are error prone
Free people to do their best work
Provides living document
Repeatable
Save time

Workshop

Why aren’t you automate ?
Share obstacles in your group

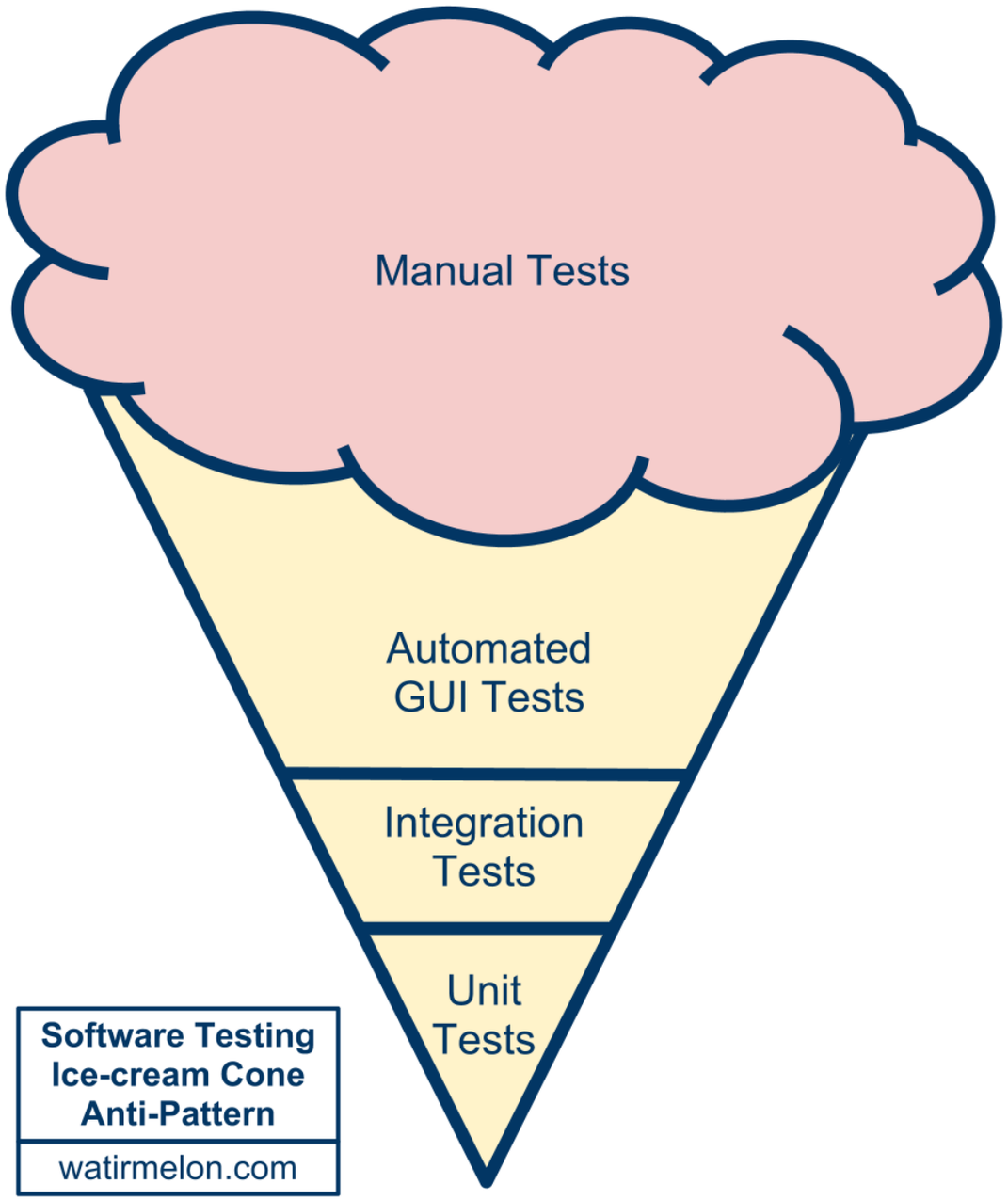
Iterative and incremental process

Done = coded and tested

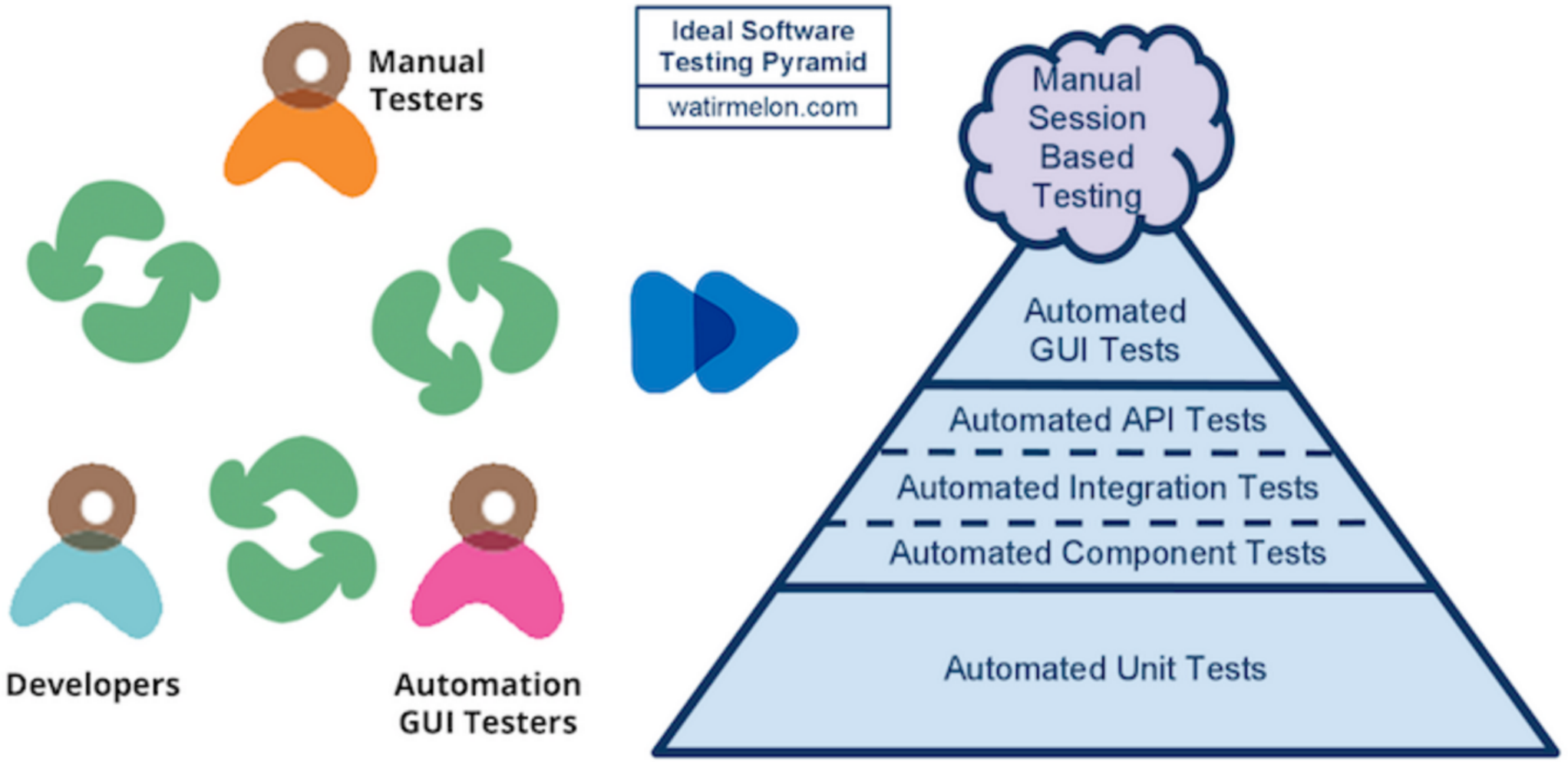


Testing pyramid

Ice-cream testing



Testing Pyramid



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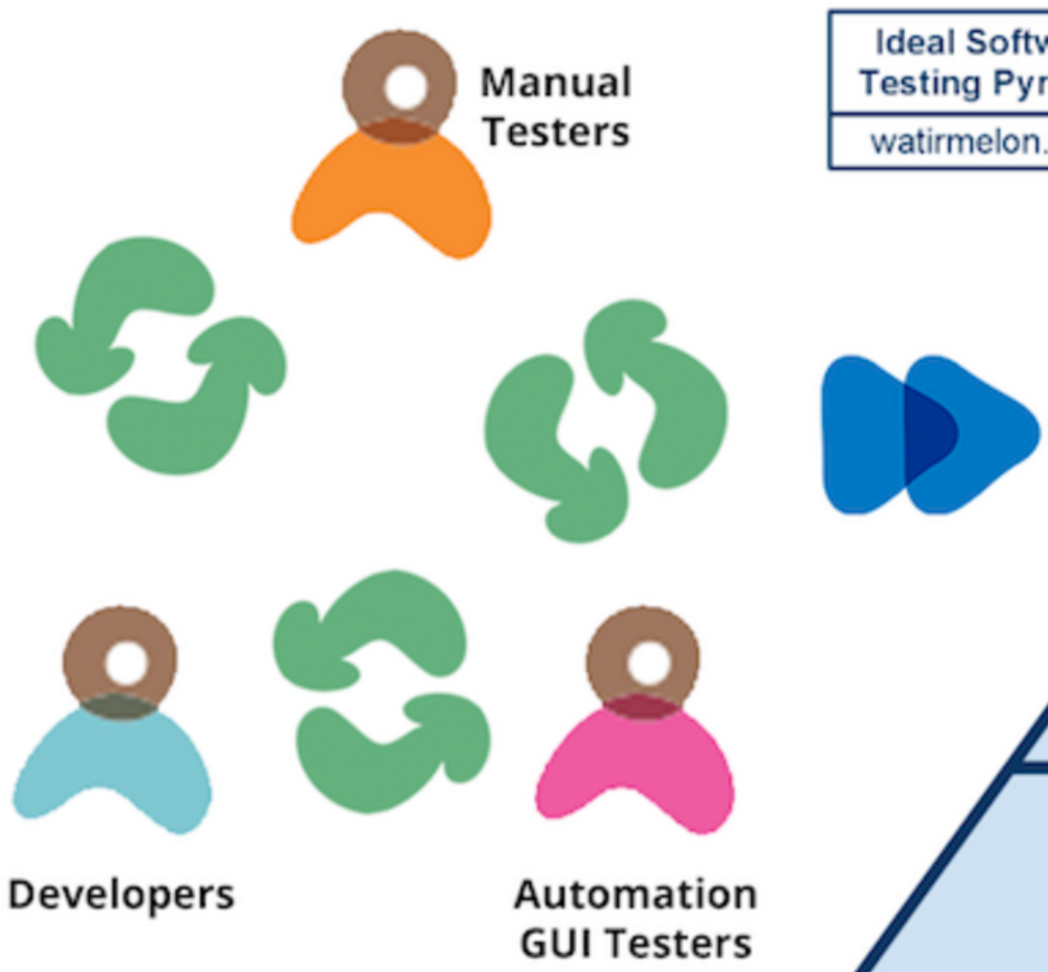
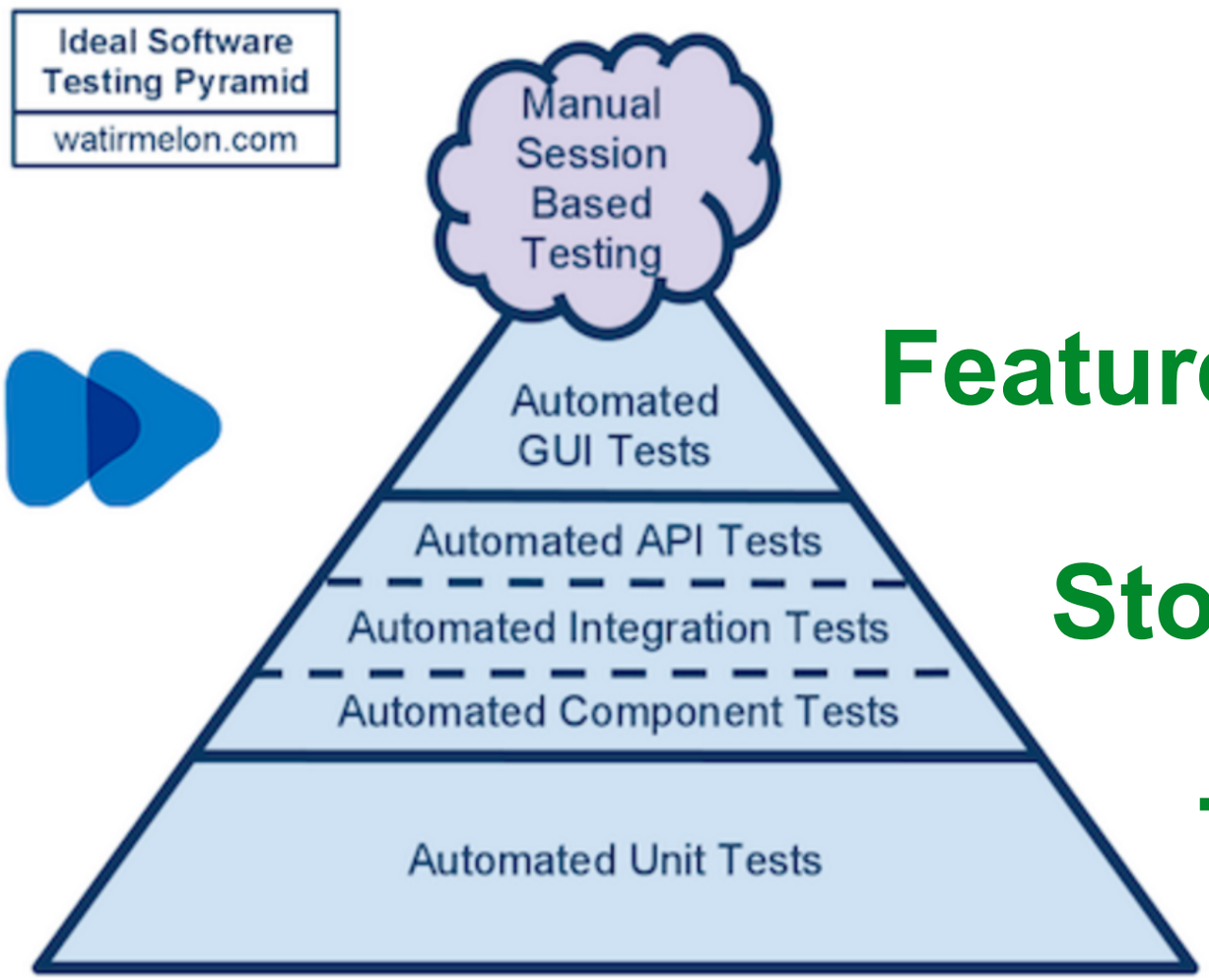
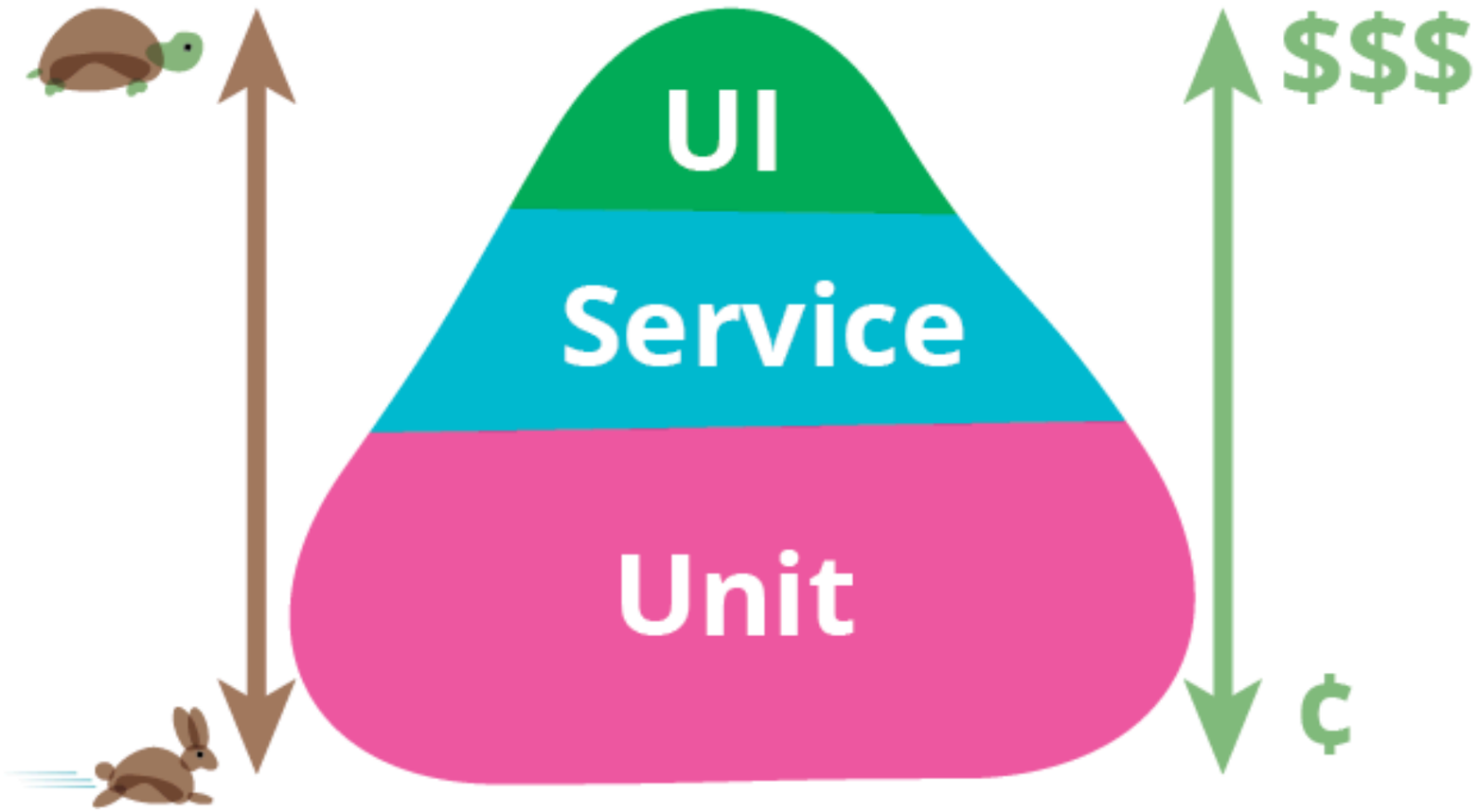
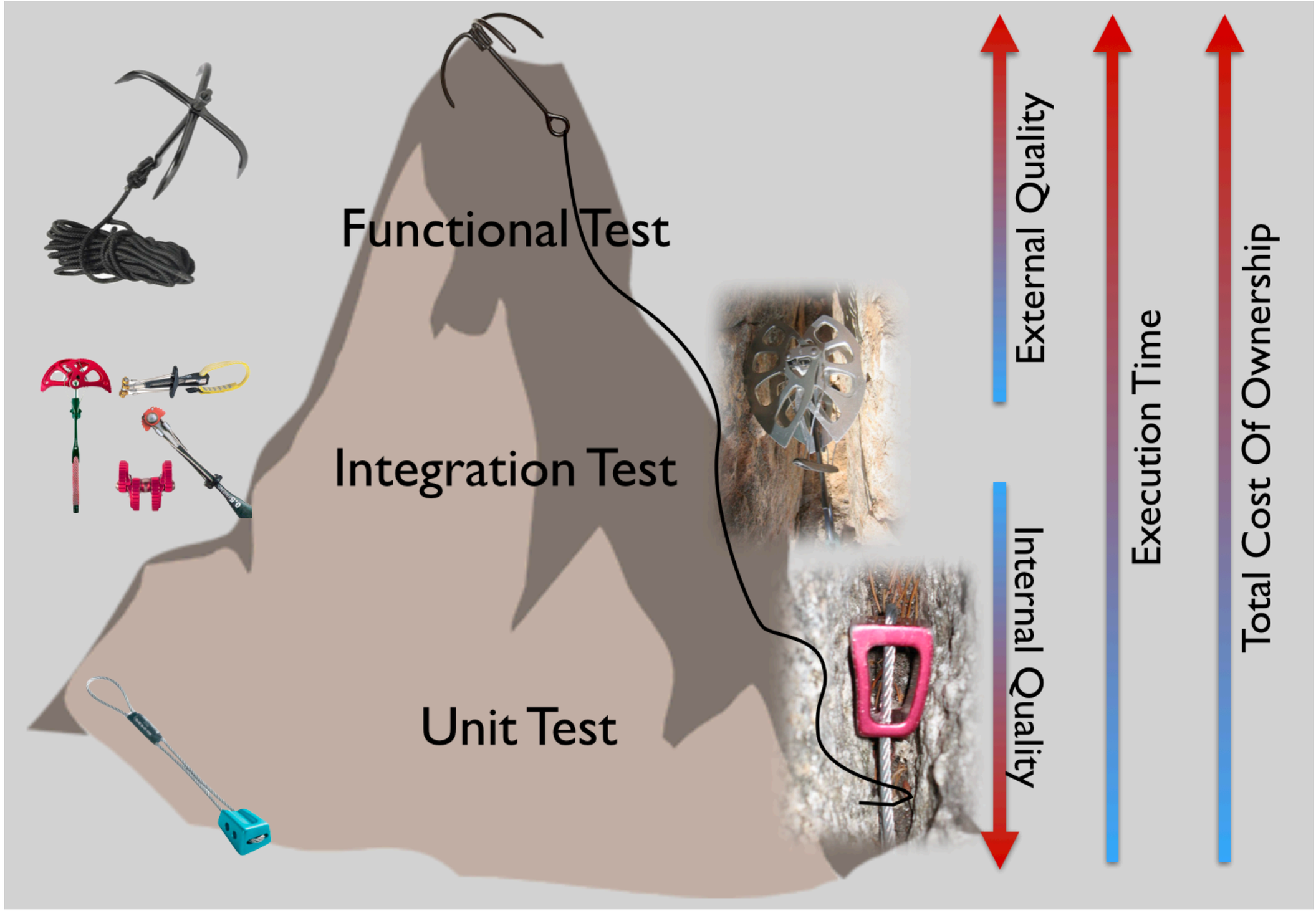




Testing Pyramid

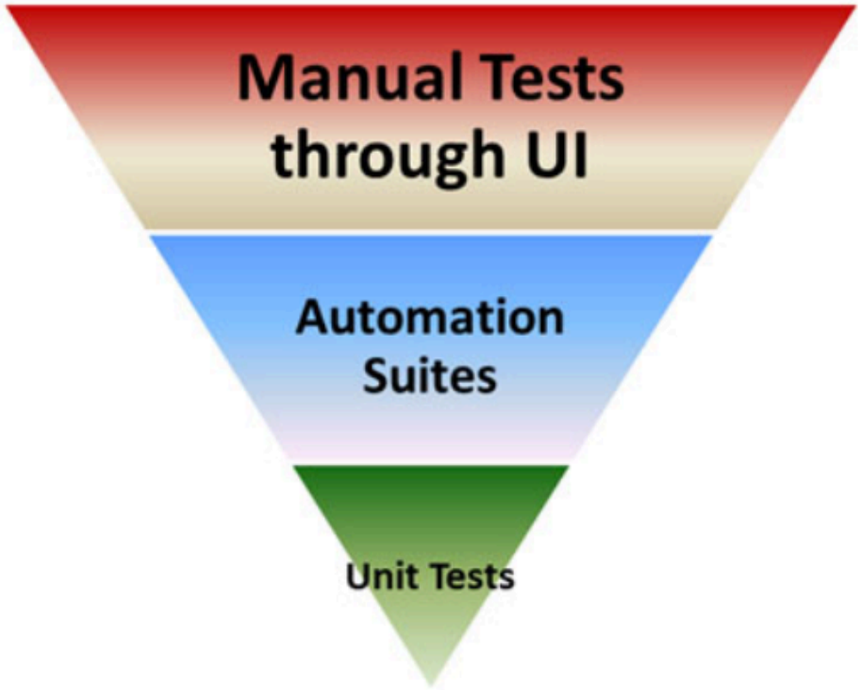


https://martinfowler.com/bliki/TestPyramid.html

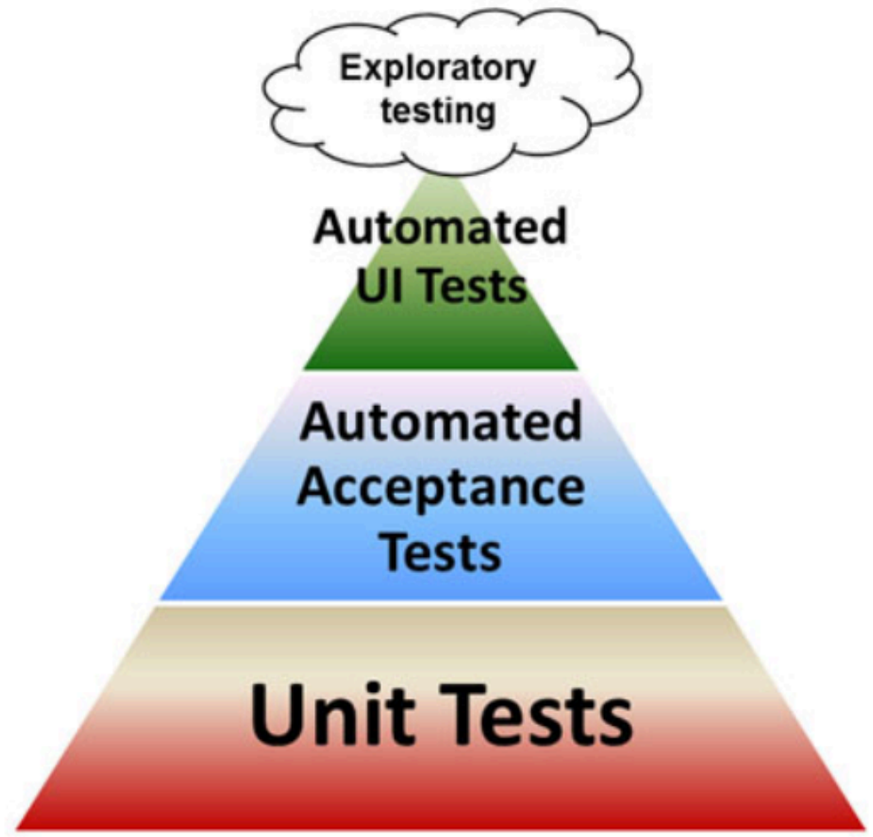


https://less.works/less/technical-excellence/unit-testing.html

Find vs Prevent



Traditional
(find bugs)



Agile
(prevent bugs)

https://martinfowler.com/bliki/TestPyramid.html

Mind-set switch

Instead of

We are here to find bug

We are here to ensure requirement are met

We are here to break the software

Mind-set switch

Instead of

We are here to find bug

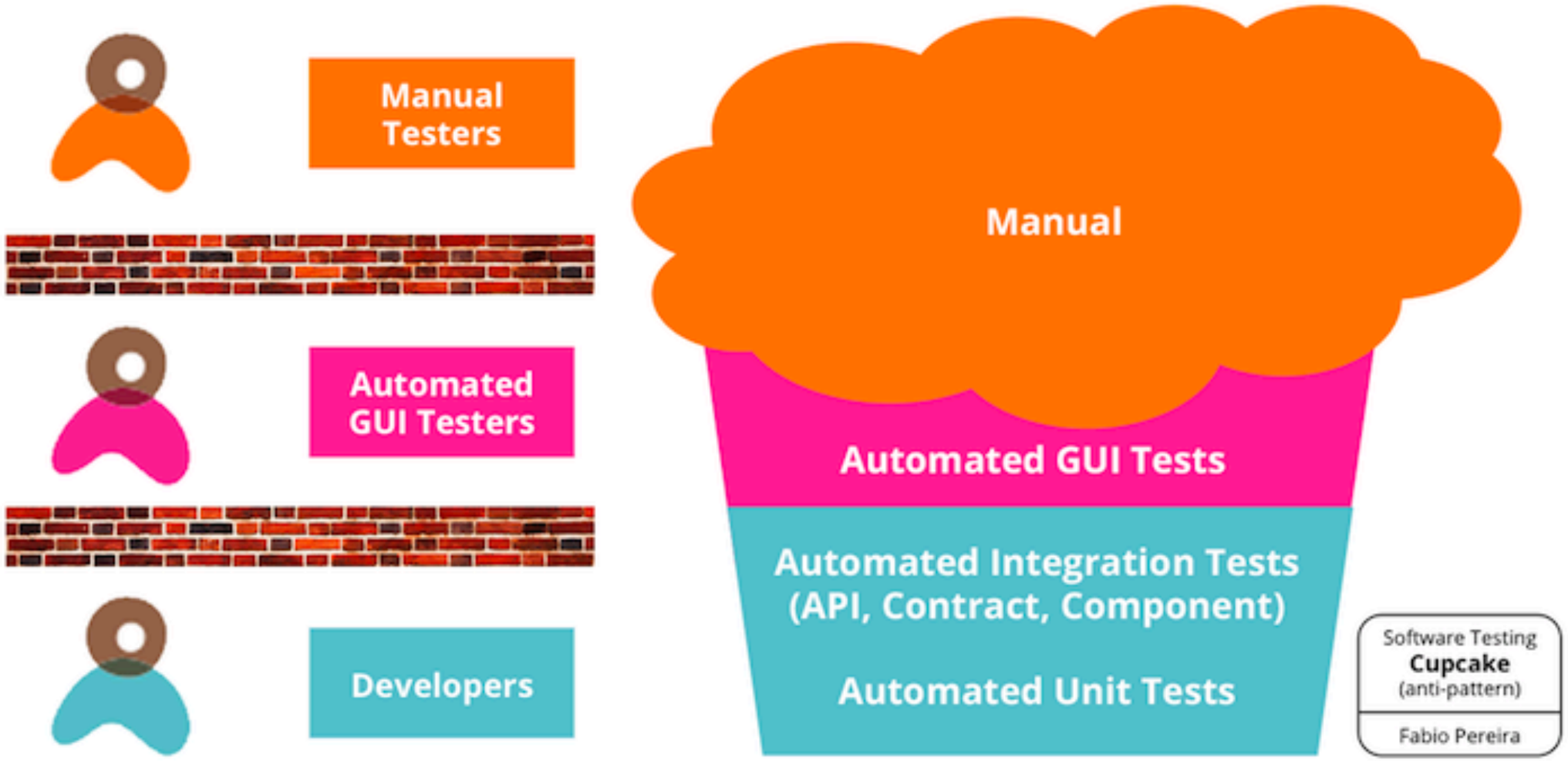
We are here to ensure requirement are met

We are here to break the software

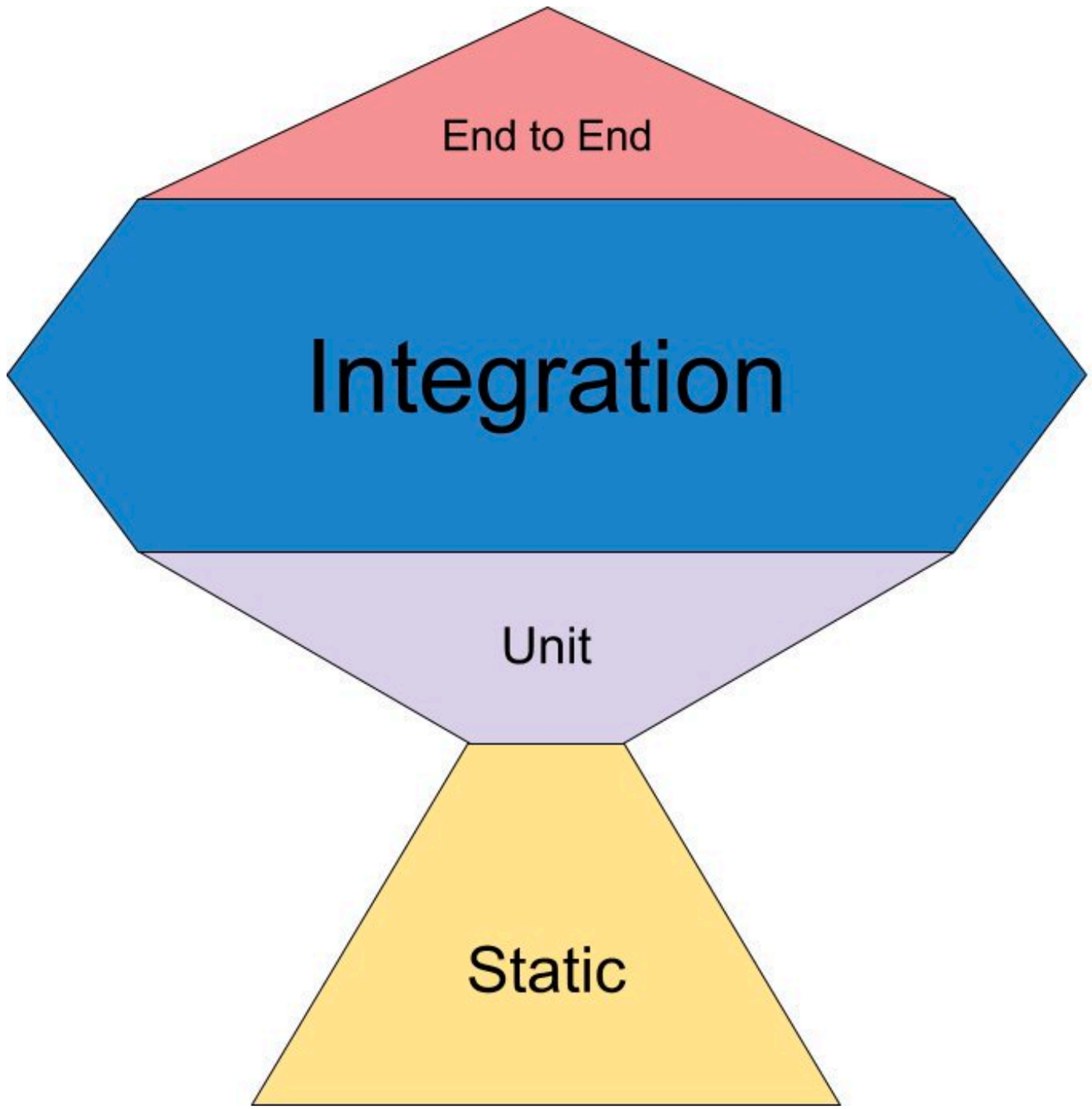
Think

What can I do to help deliver the software successfully !!

Cupcake testing



Trophy testing



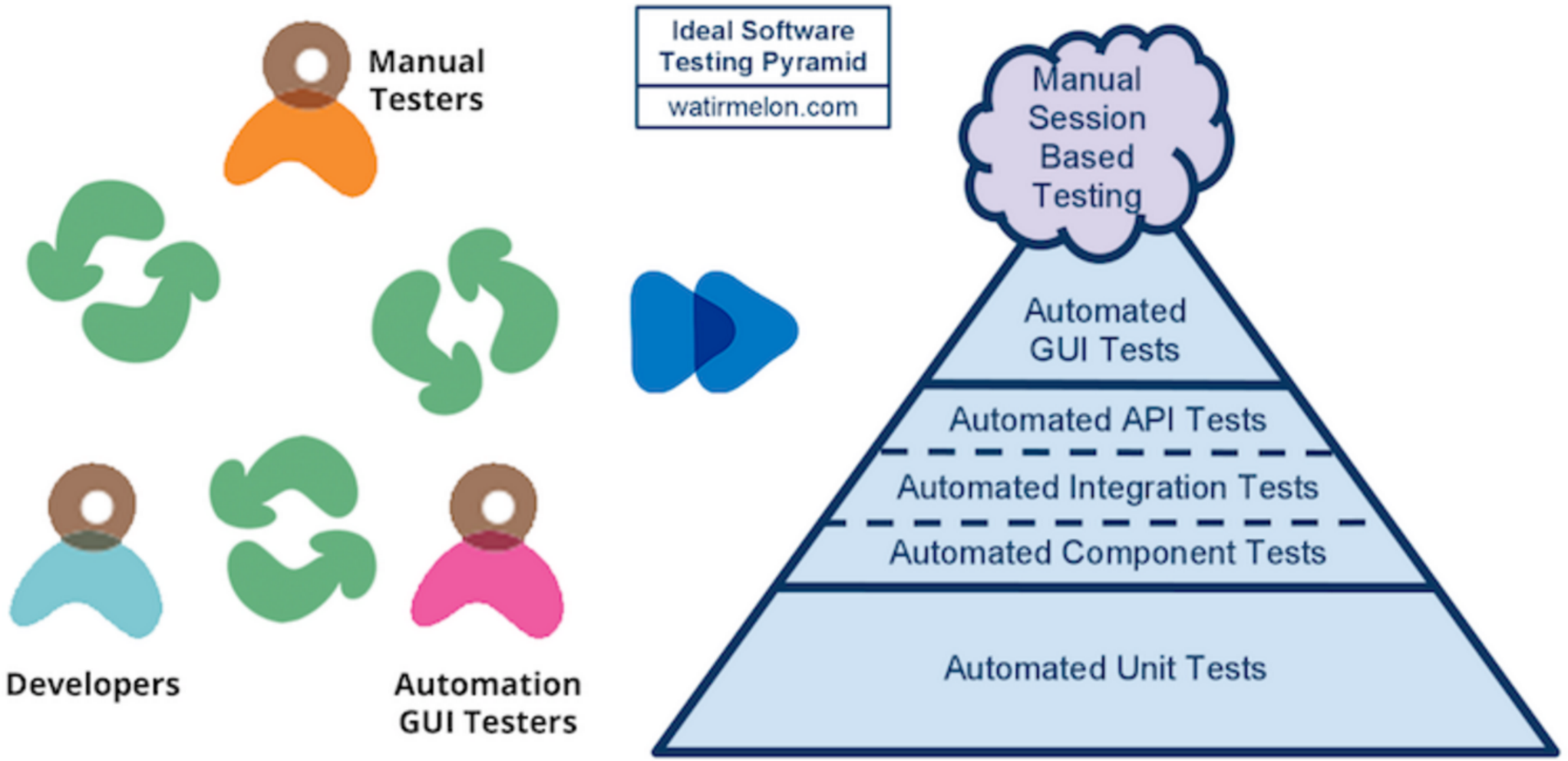
Workshop Test Pyramid

Test login

User name	Password	Expected result	Comment
Somkiat	PasswordSomKiat	Access to system as Somkiat	Valid
Som kiat	PasswordSomKiat	Error	Space in user
Somkiat	Password SomKiat	Error	Space in password
Somkiat	1234	Error	Password too short

Workshop

1. Draw a test pyramid
2. Identify tests at each level
3. Think about value (business and customer)
4. What tests should be manual ?



Understand What and How to test ?

Discussion is very important

Remember !!

Test pyramid is a tool
To talk about automation tasks
How to prioritise and help to do automation ?
Way to make **visible to the whole team**

Where to start ?

What are the **biggest obstacles** ?

Time/Tools/System/People

What should be careful ?

Automating end-to-end tests

User Interface are slow

Working with database

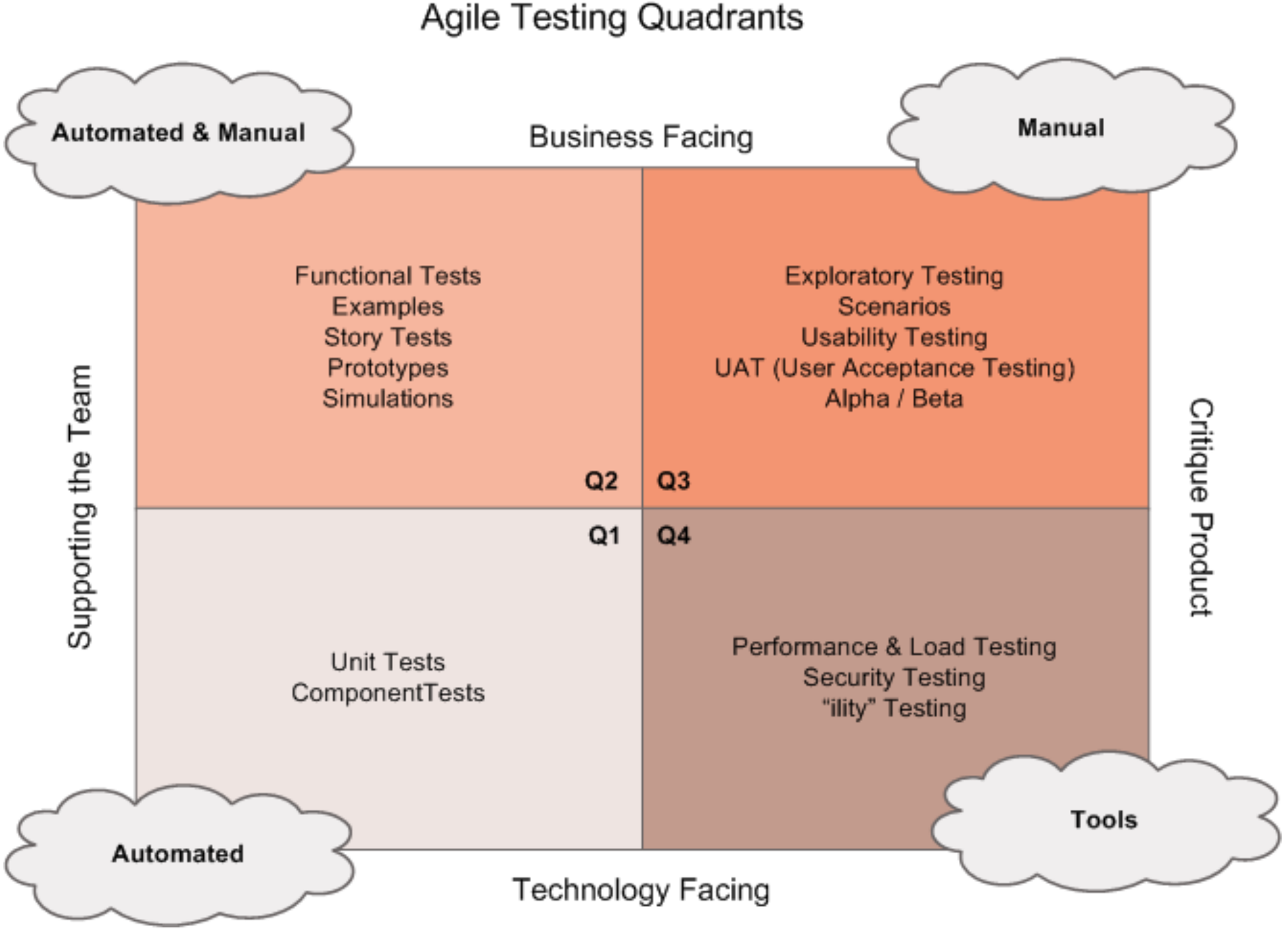
Working with external system

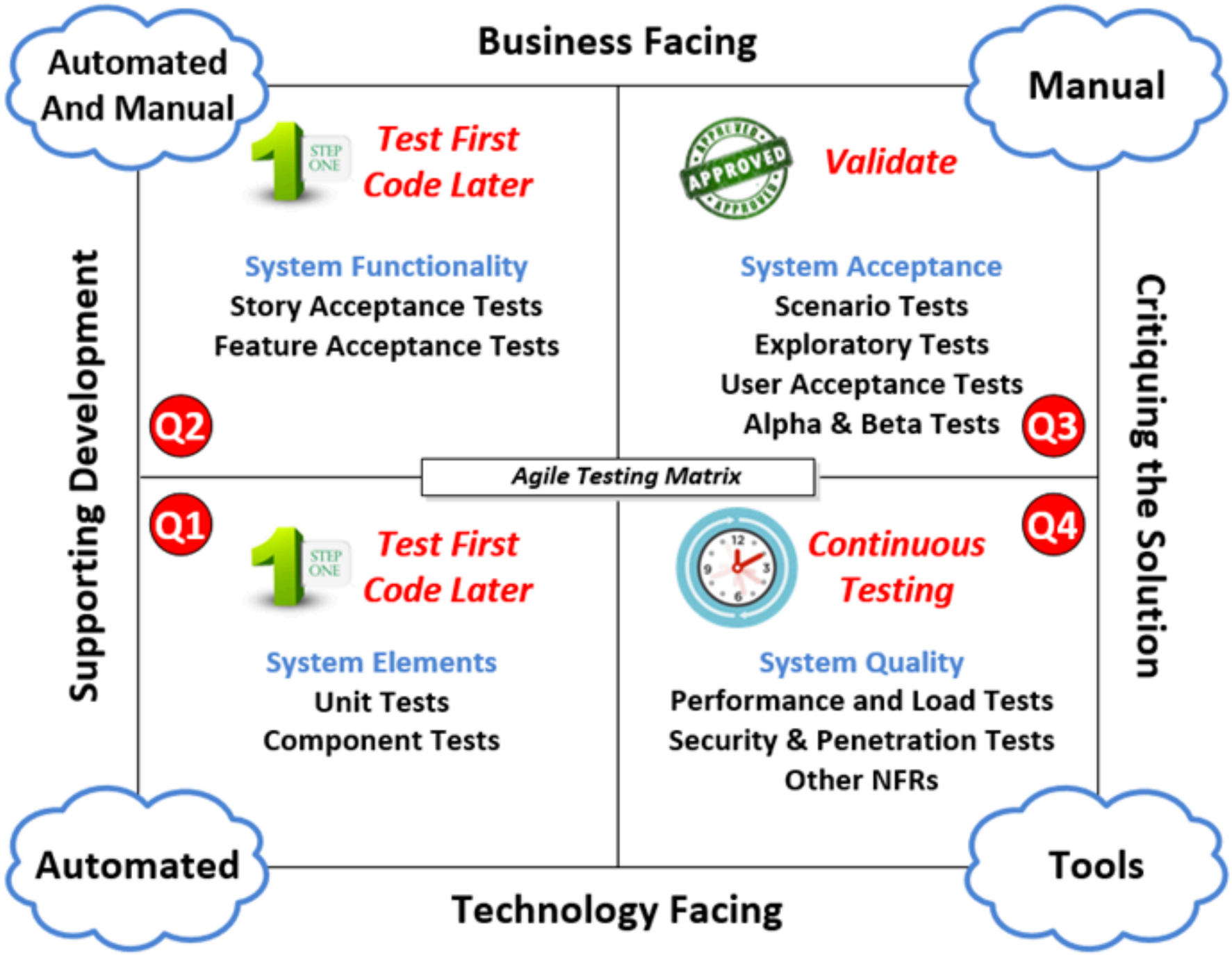
Automating every paths

Testing Quadrant

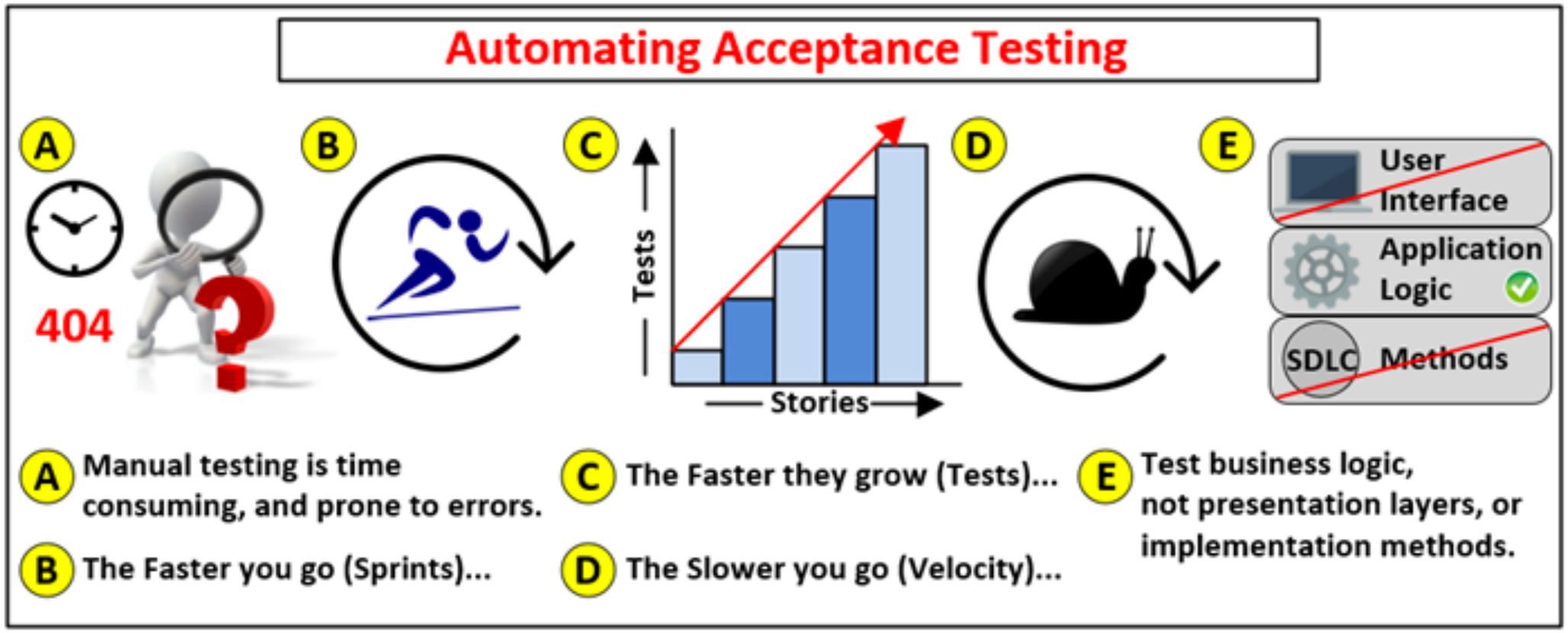
Testing Quadrants

Scope of tests
Classify your tests
Visible your tests





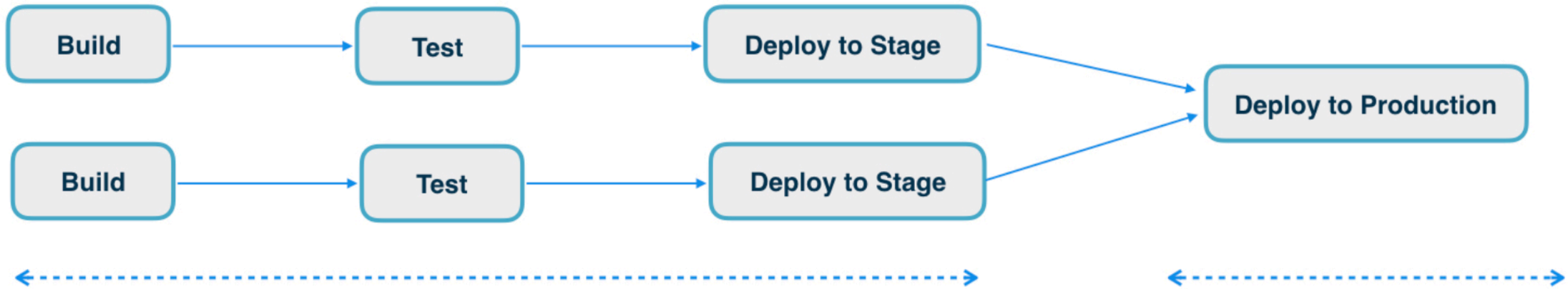
Test automation is essential

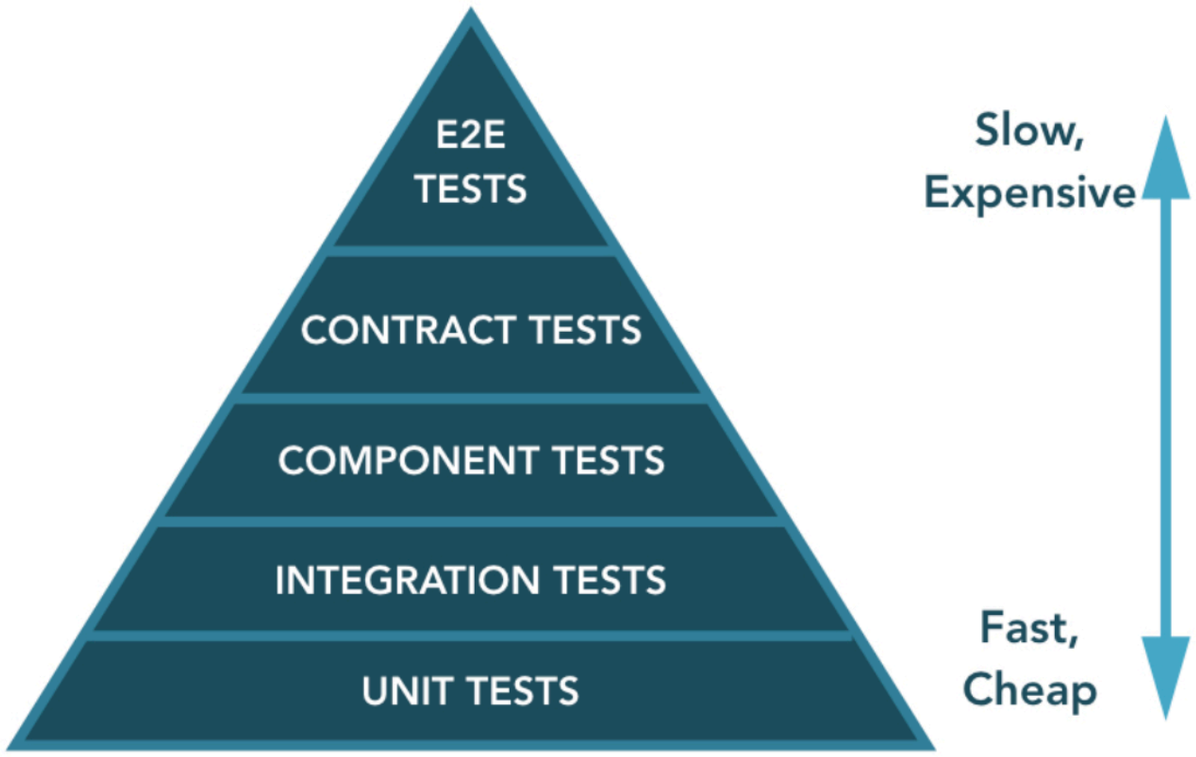


Test strategy

https://martinfowler.com/articles/microservice-testing/

Test strategy

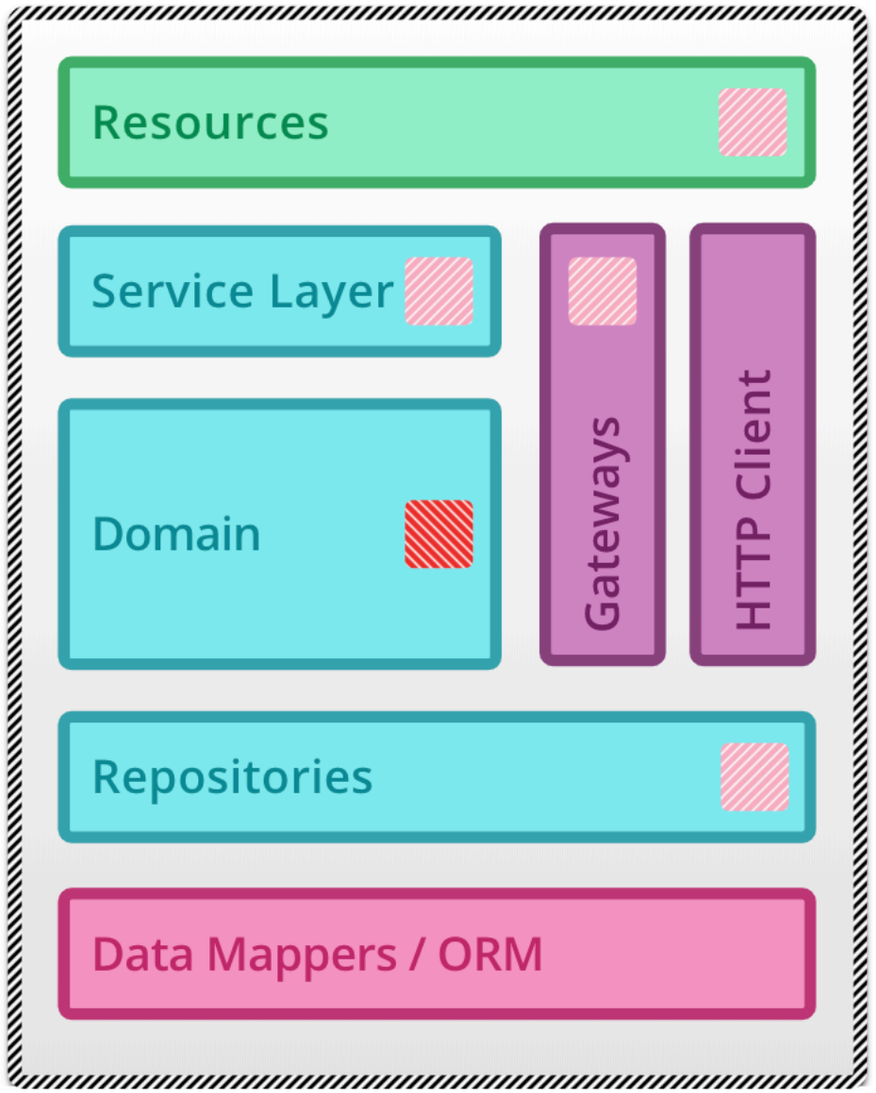




Monitoring
Distributed Tracing
Fault-injection Testing

Canary Deployments
Blue-Green Deployments
A/B Testing

Unit testing

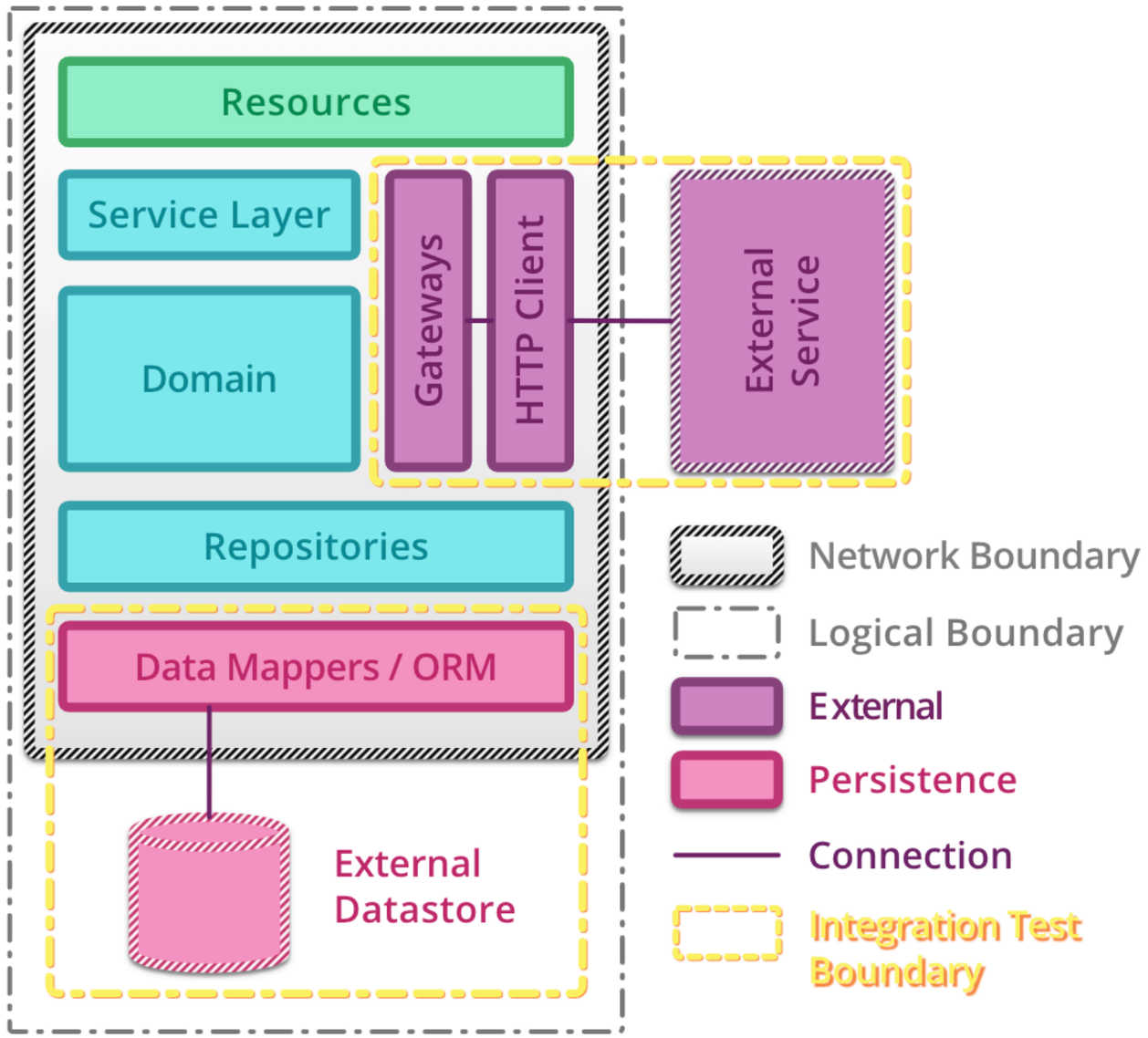


Services are commonly a
coordination code.

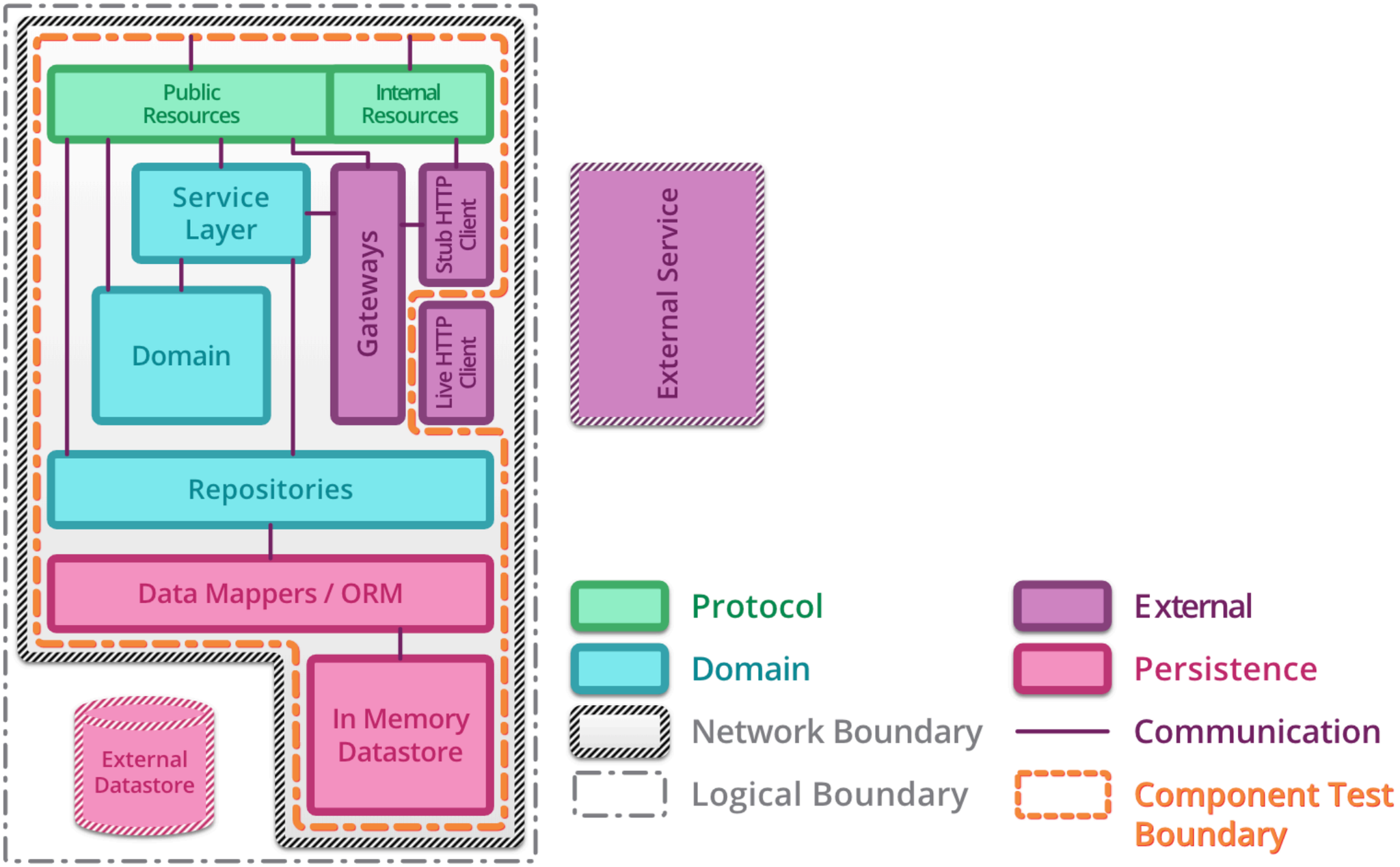
Unit - Solitary

Unit - Sociable

Integration testing



Component testing



Test design

Economy of Test Design

Easy to understand
Easy to maintain
Readable by the business
One purpose per test
Re-runnable

Economy of Test Design

Easy to understand
Easy to maintain
Readable by the business
One purpose per test
Re-runnable

Poor test practices reduce the benefits

Respect your tests

Don’t ignore it if it fails

Fix the code or fix the test

100% of regression tests must pass all the time

Always refactor or improve

Test data !!

Avoid database/external system access

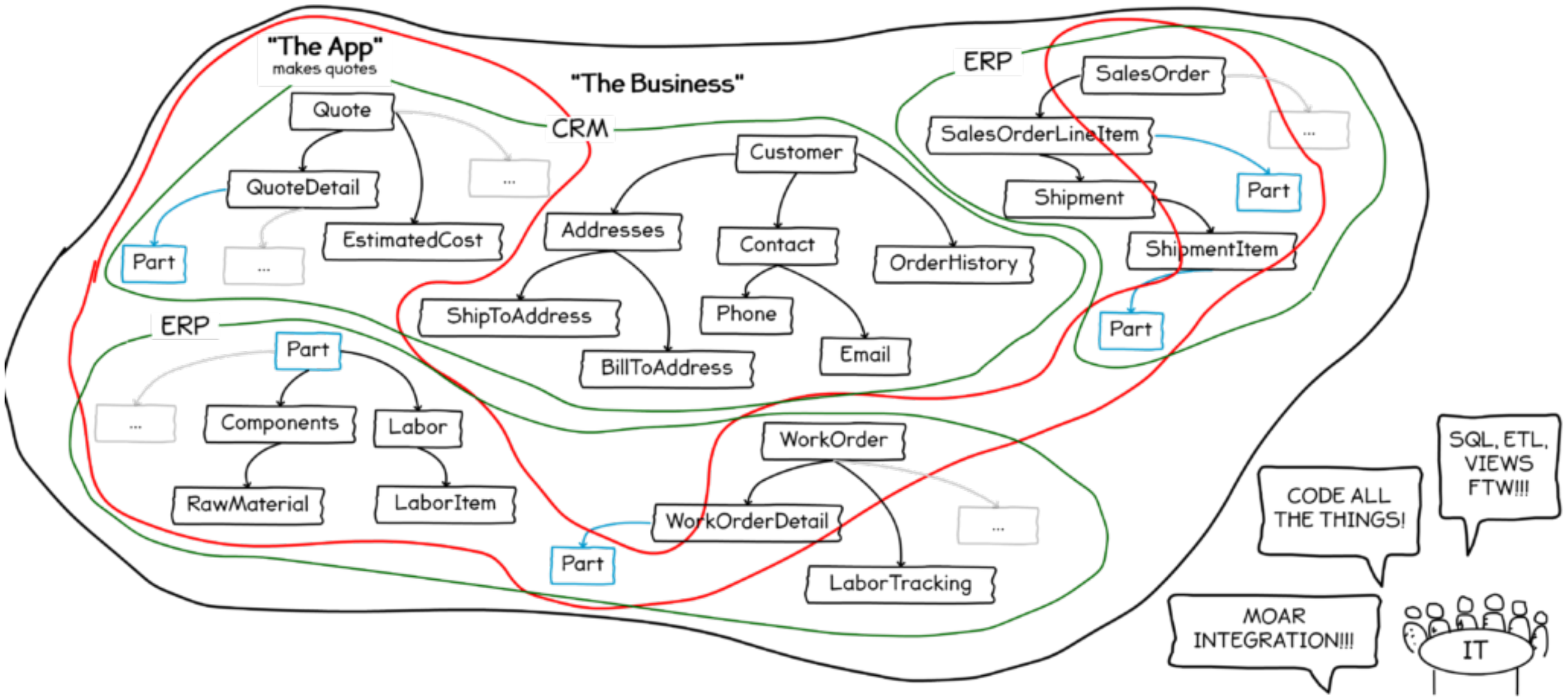
Setup/ tear down test data

Use production-like data

Need to control your data test

System impacts !!

Know your systems

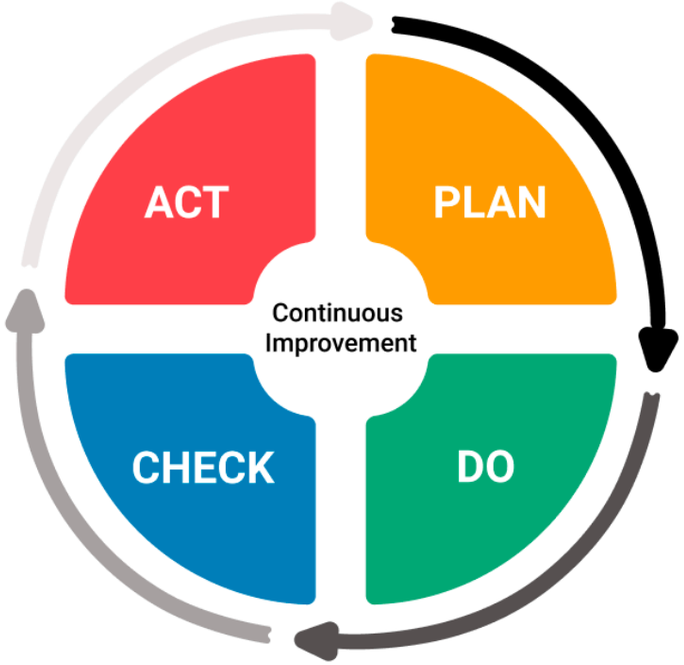


Automation feedback

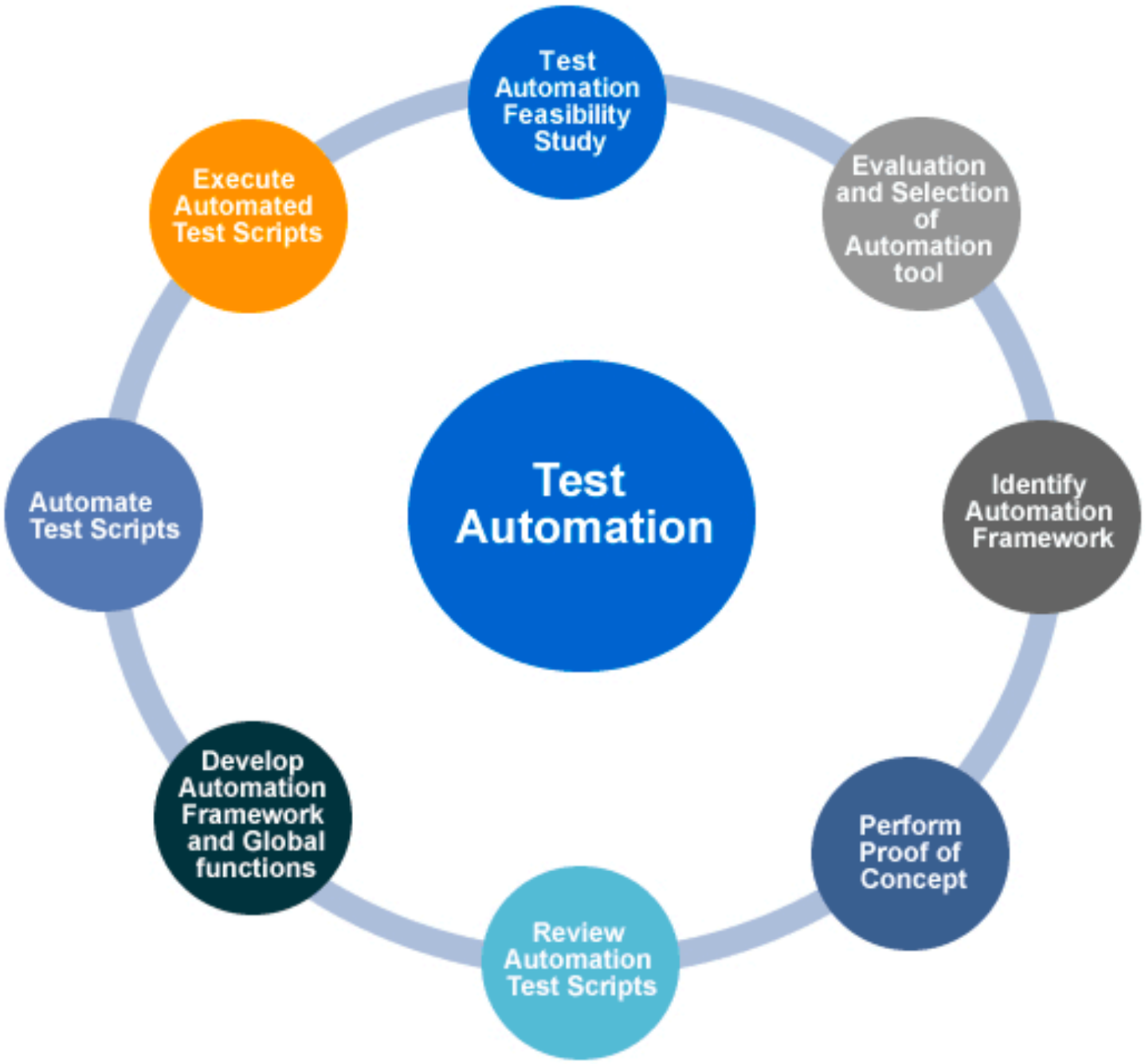
Easier over time ?

Time spent on maintenance ?

Test find regression bugs ?



Test Automation selection



Manage automated tests

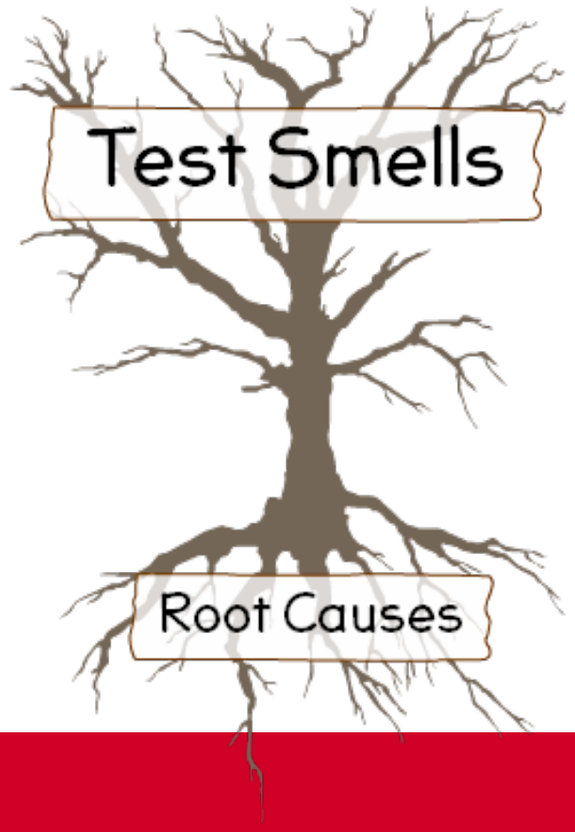
Use source control

Continuous integration to run tests on every change

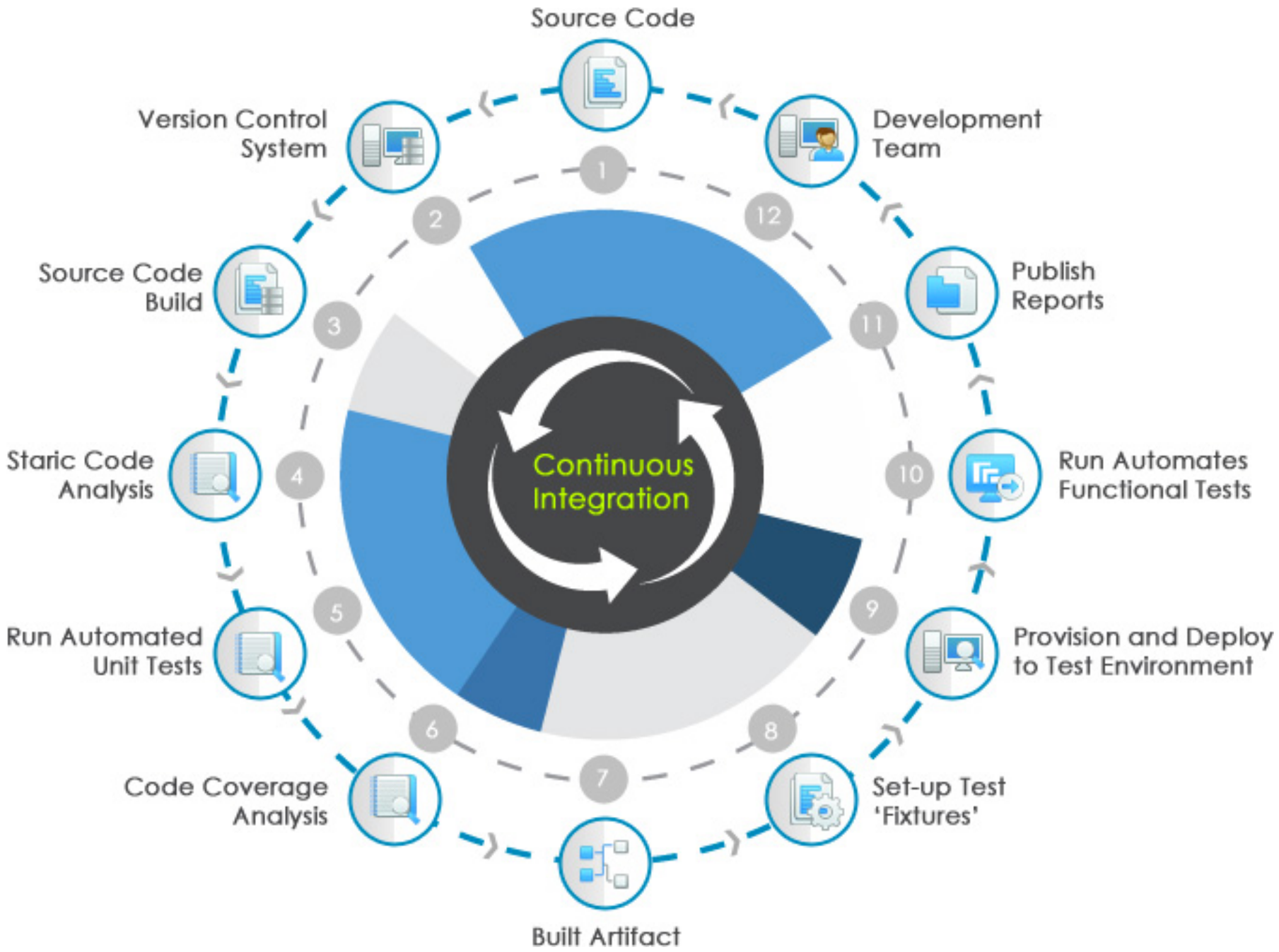
Keep all tests passed

Analyse failures tests

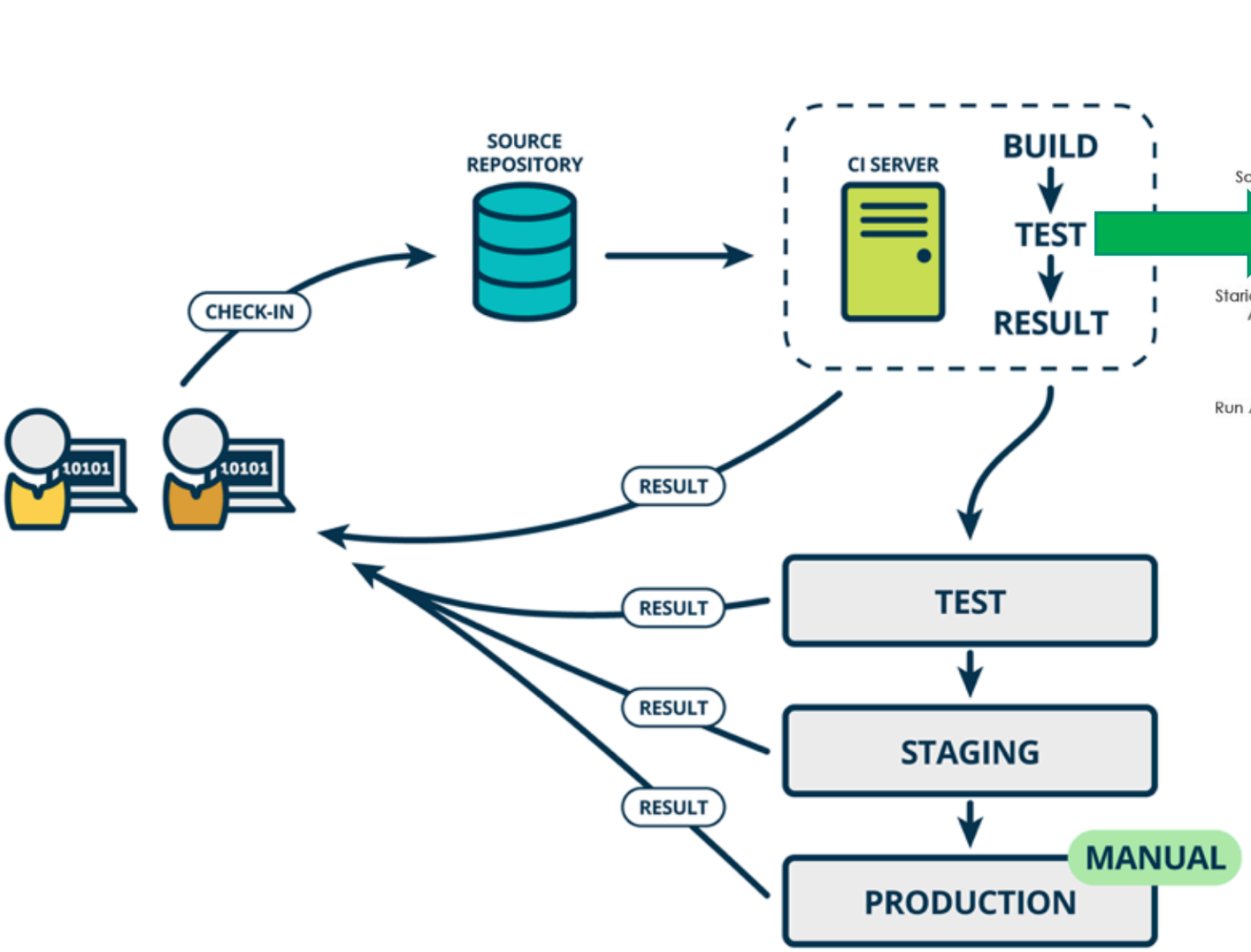
Create test standard



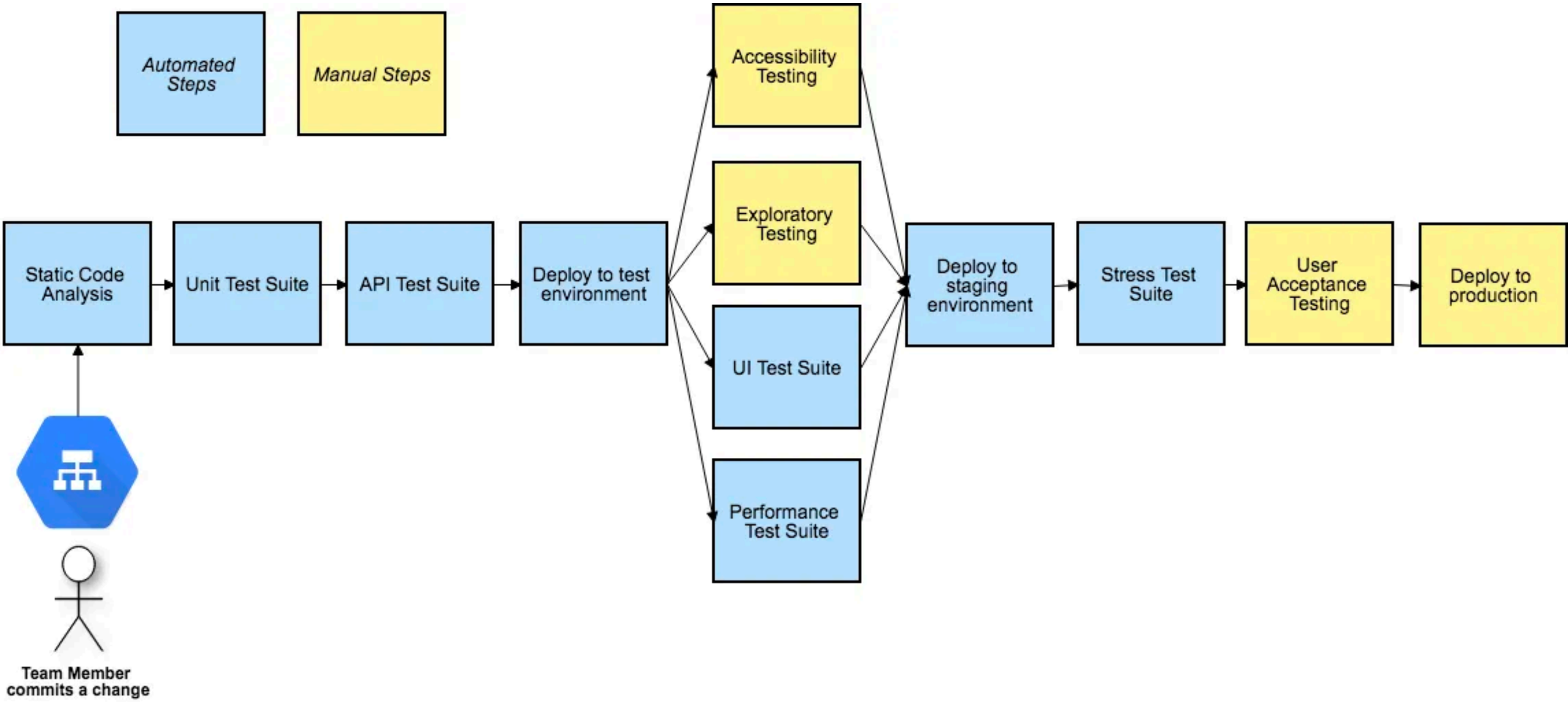
Continuous integration



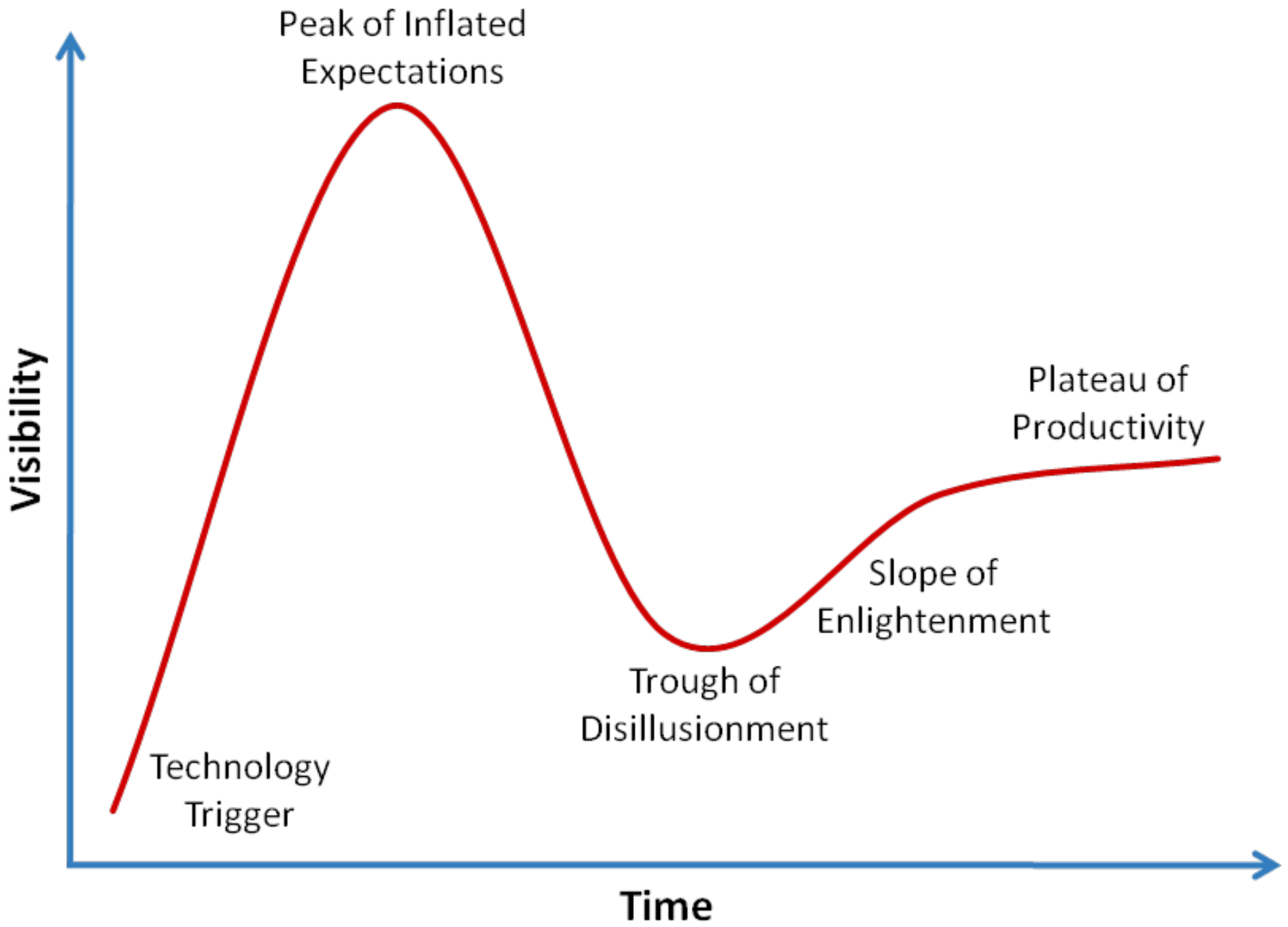
Continuous integration



Design your pipeline/process



Hype cycle



Start with simple

Use feedback to improve

Automate Unit Tests

What Unit test ?

Software programs written to exercise other software programs with **specific preconditions** and verify the **expected behaviours**

Usually written in the **same programming language**

Test code

Production code

What Unit test ?

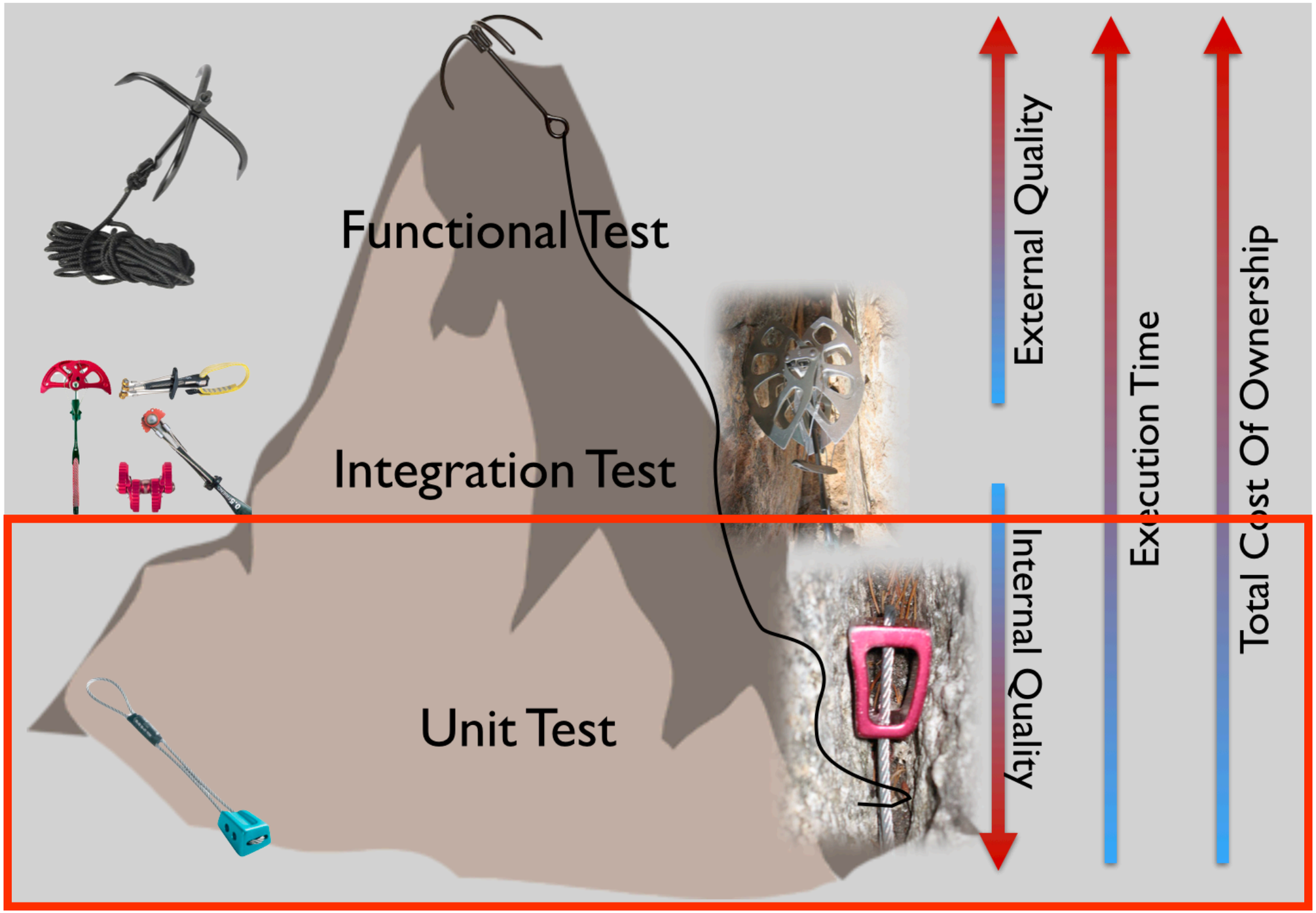
Small and test only limited line of code functionality

Run very fast (100+ within a few seconds)

Golden rule of Unit test

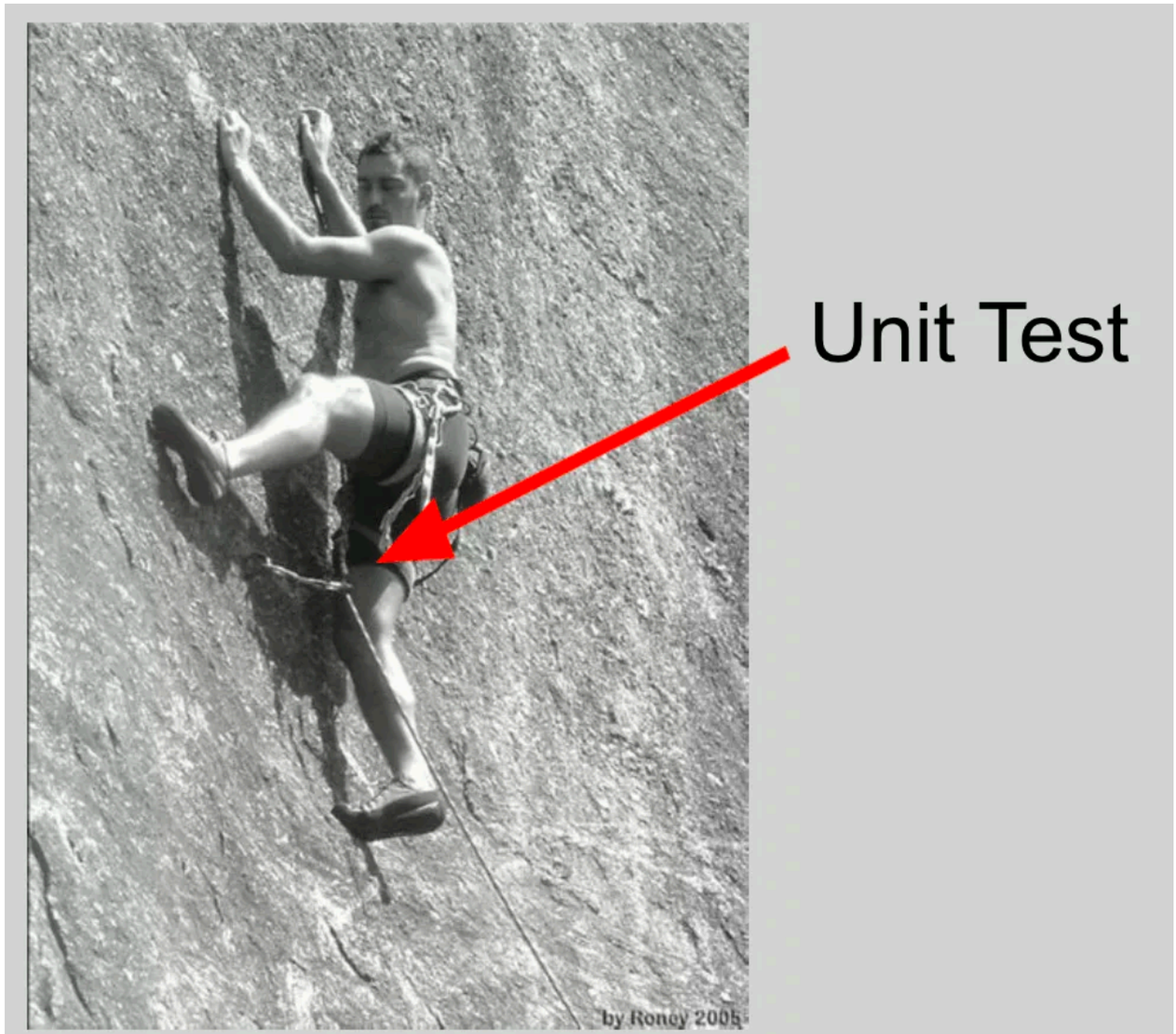
Each unit test case should be
very limited in scope

Why Unit test ?



Why Unit test ?

Protect what we have implemented than to find any defects



Purpose of Unit test

Facilitates changes

Simplifies integration

Documentation

Design tool

Good Unit Tests (F.I.R.S.T)

Fast

Independent/Isolate

Repeat

Self-validate

Thorough/Timely

We need testable code and easy to test

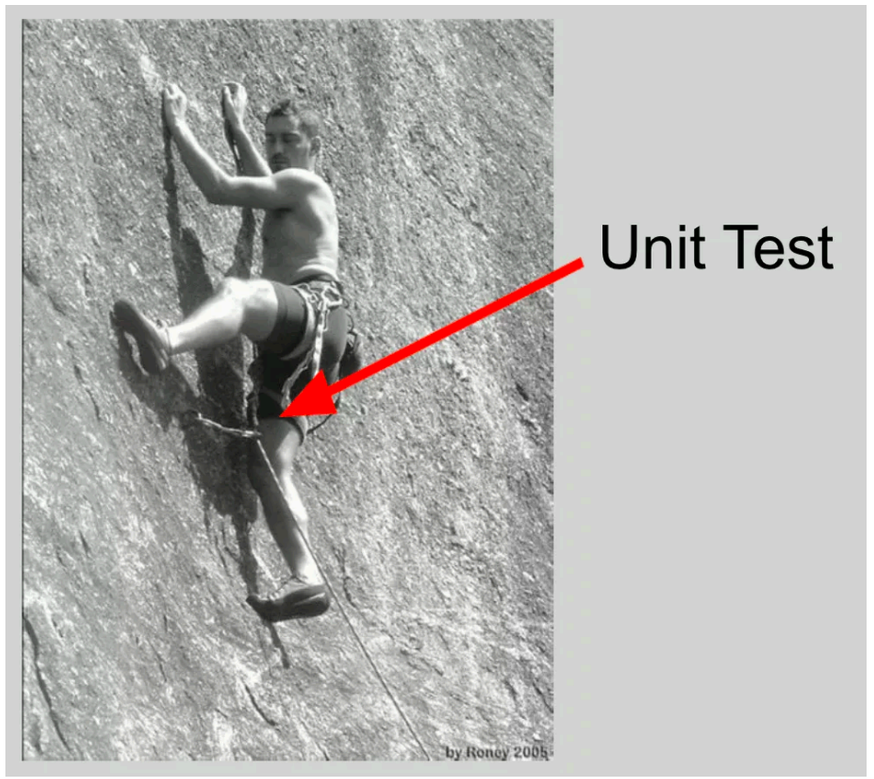
Misconception of Unit test

Not as important as the production code

Done by testing engineers

Write unit test without changing production code

Add unit test later



Maximize test accuracy

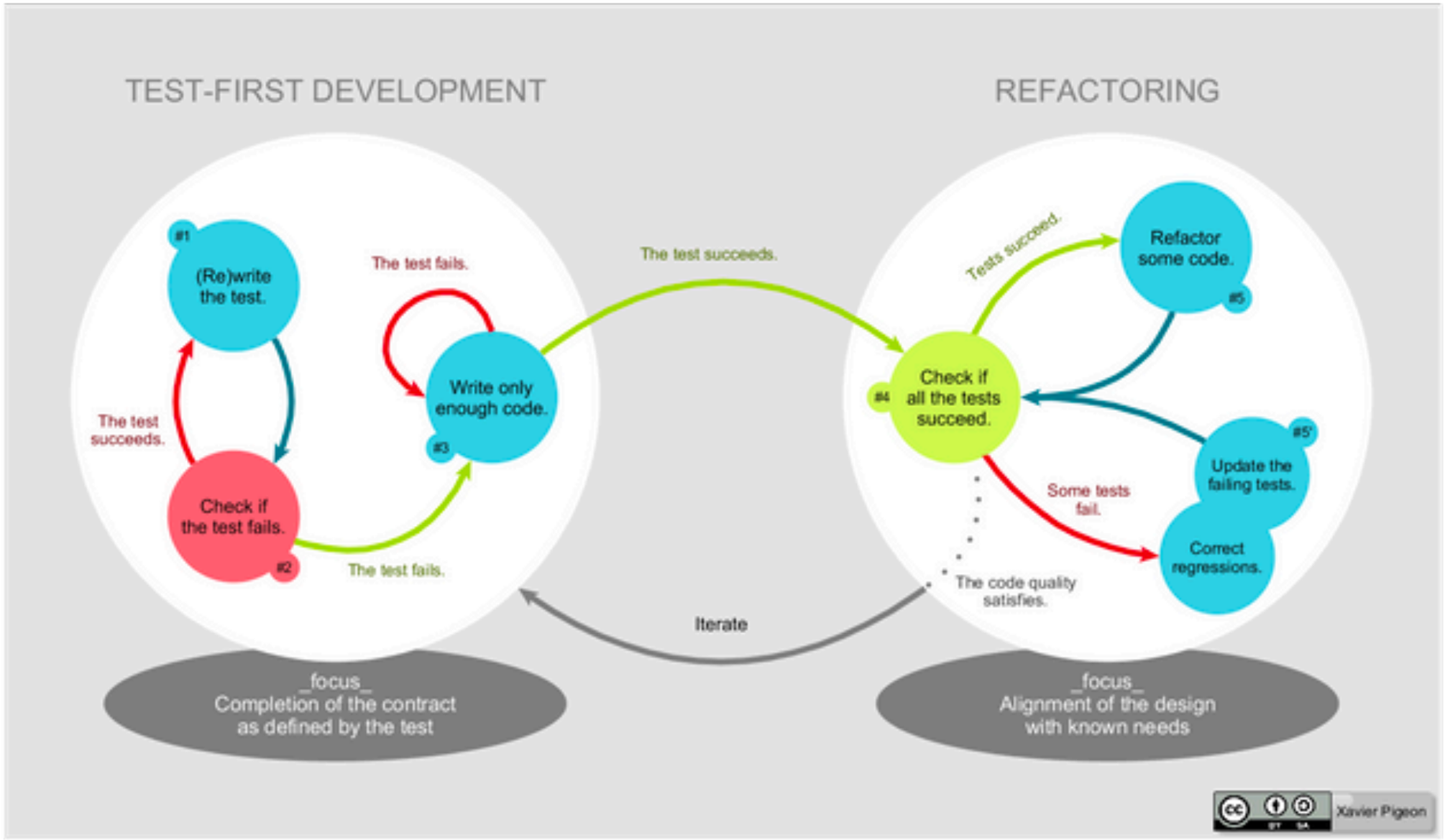
Table of error types		Functionality is	
		Correct	Broken
Test result	Test passes	Correct inference (true negatives)	Type II error (false negative)
	Test fails	Type I error (false positive)	Correct inference (true positives)

Protection against regressions

Resistance to refactoring

Let’s start with Test-First

Test-First

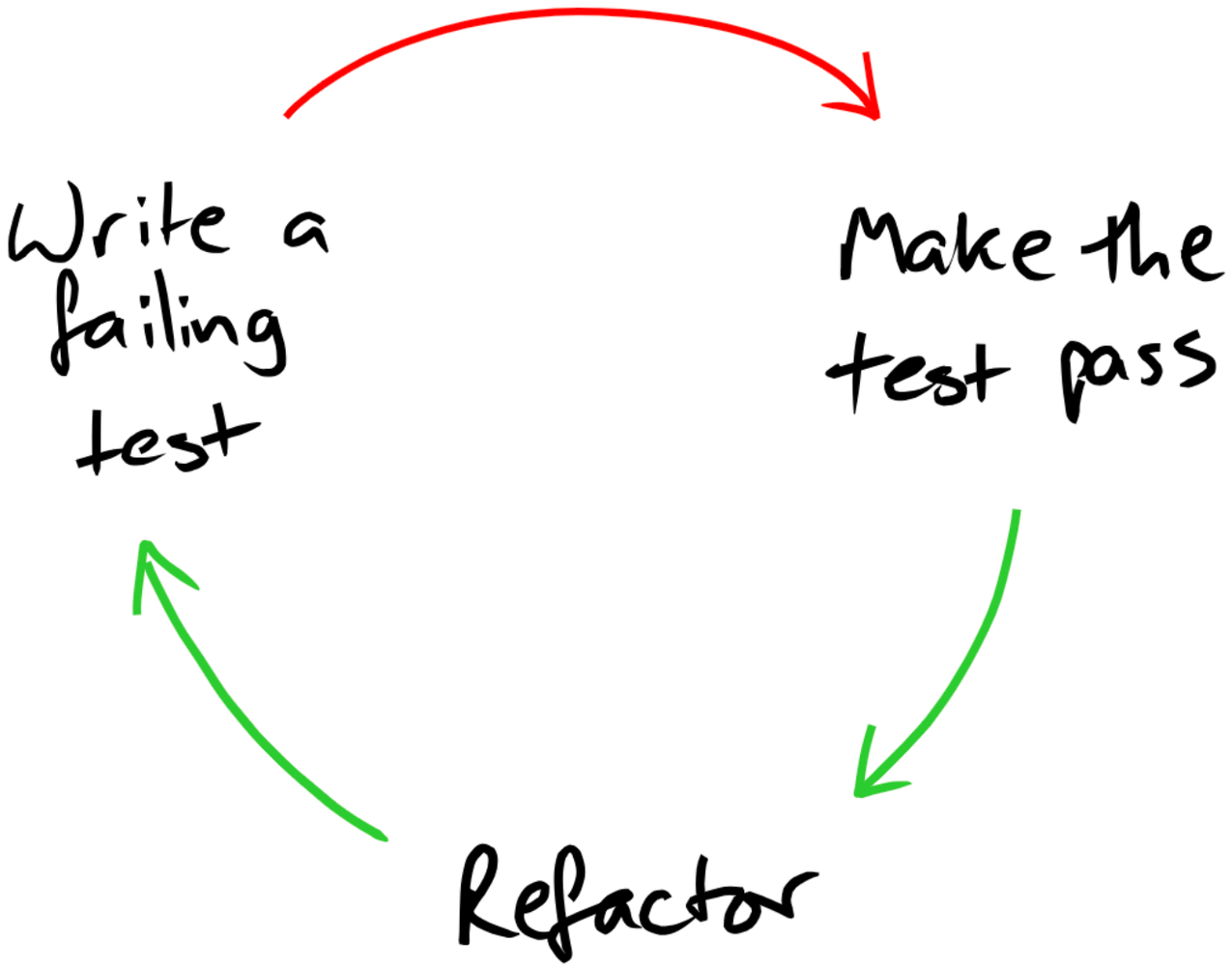


TDD

ALL CODE IS GUILTY UNTIL PROVEN INNOCENT

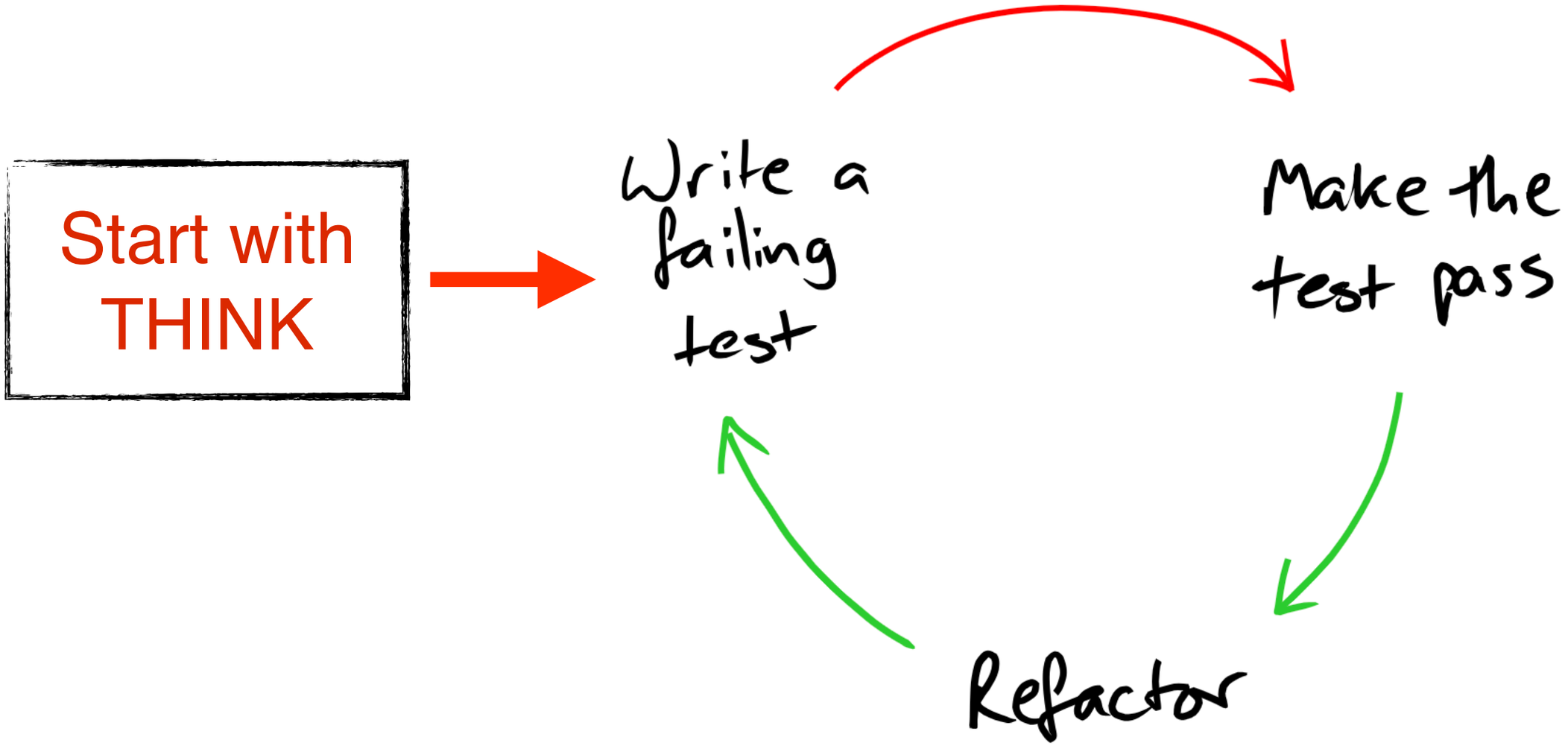
TDD === ทำดีดี

TDD Cycle

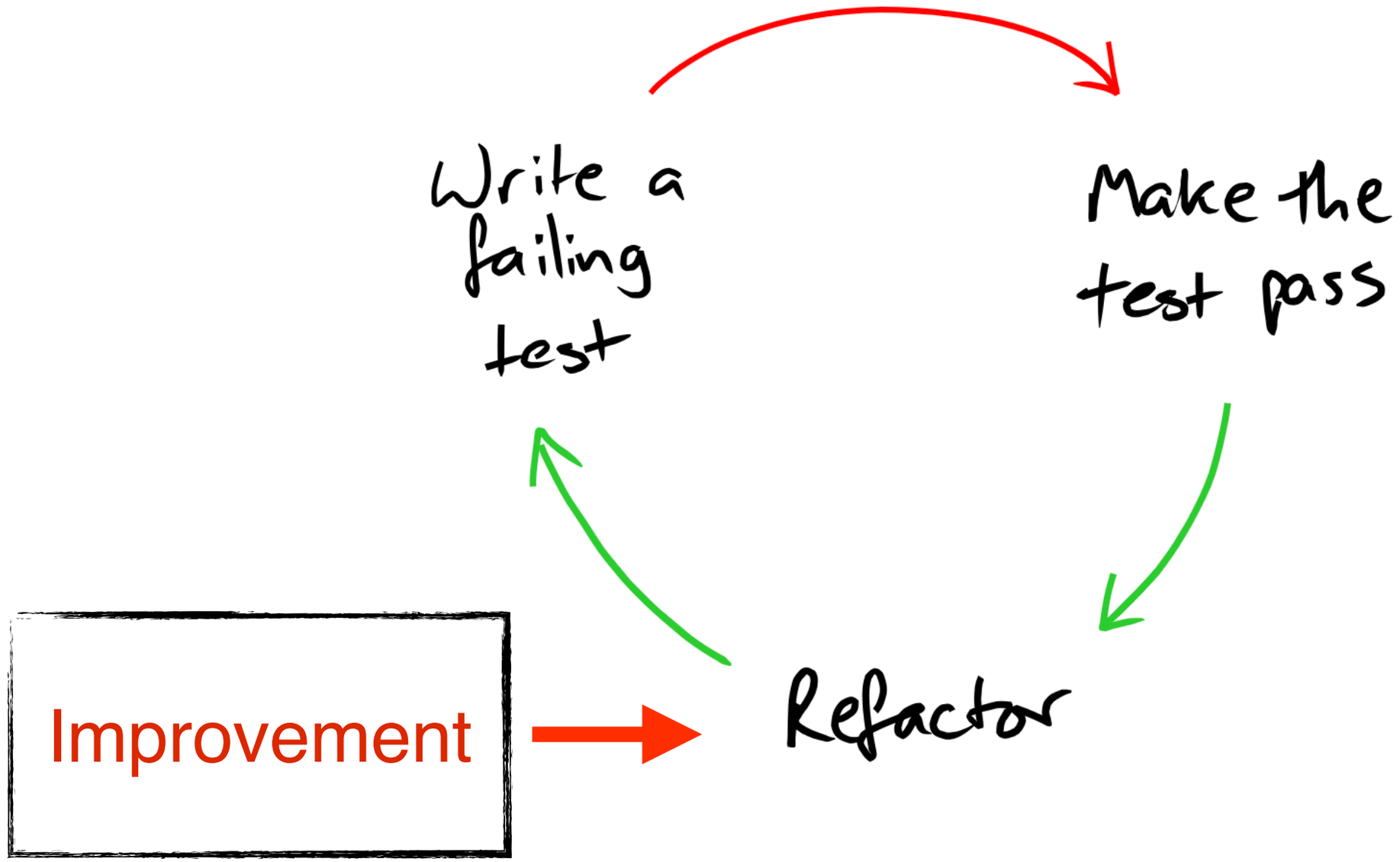


Red Green Refactor

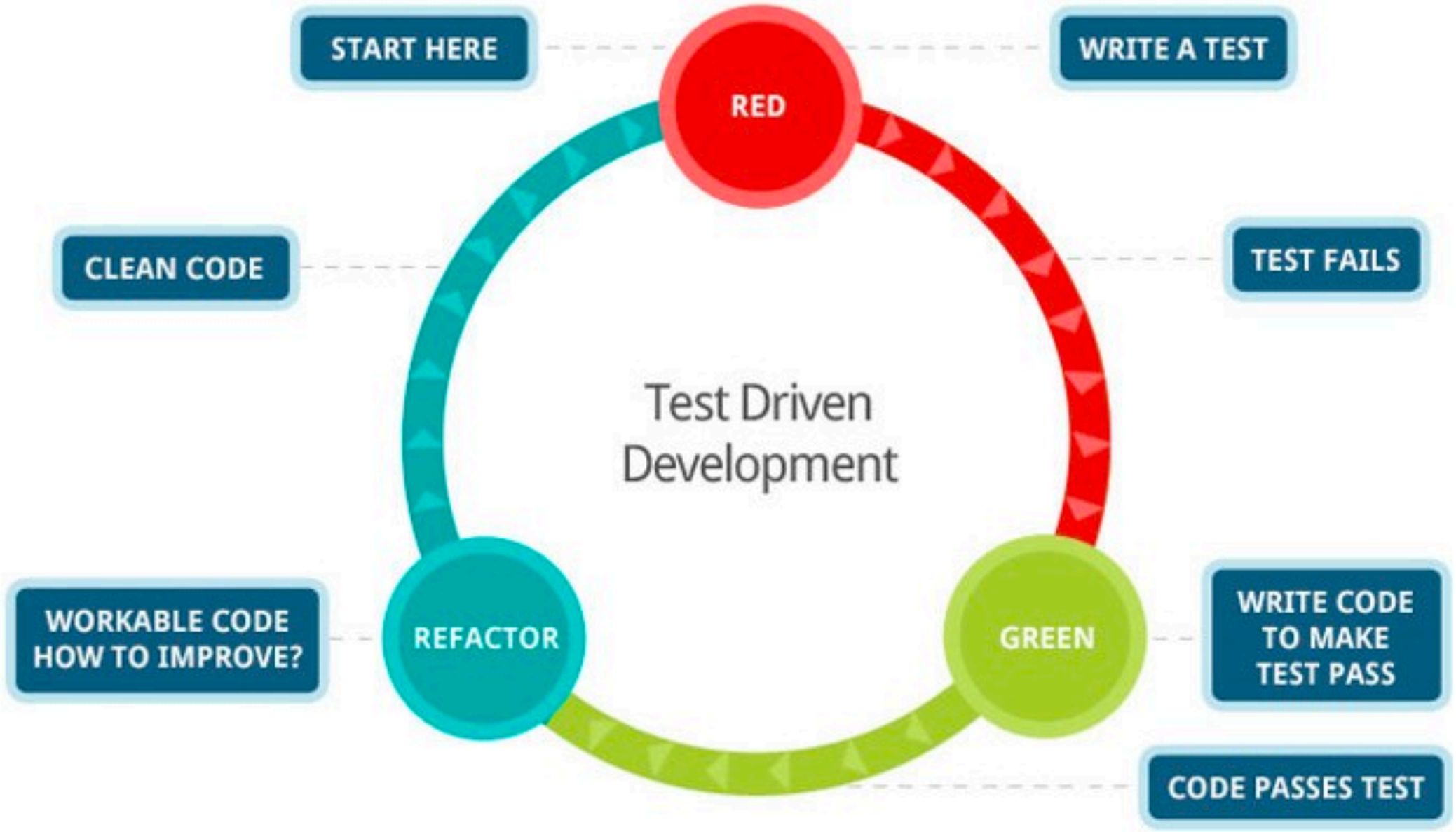
Improve TDD Cycle



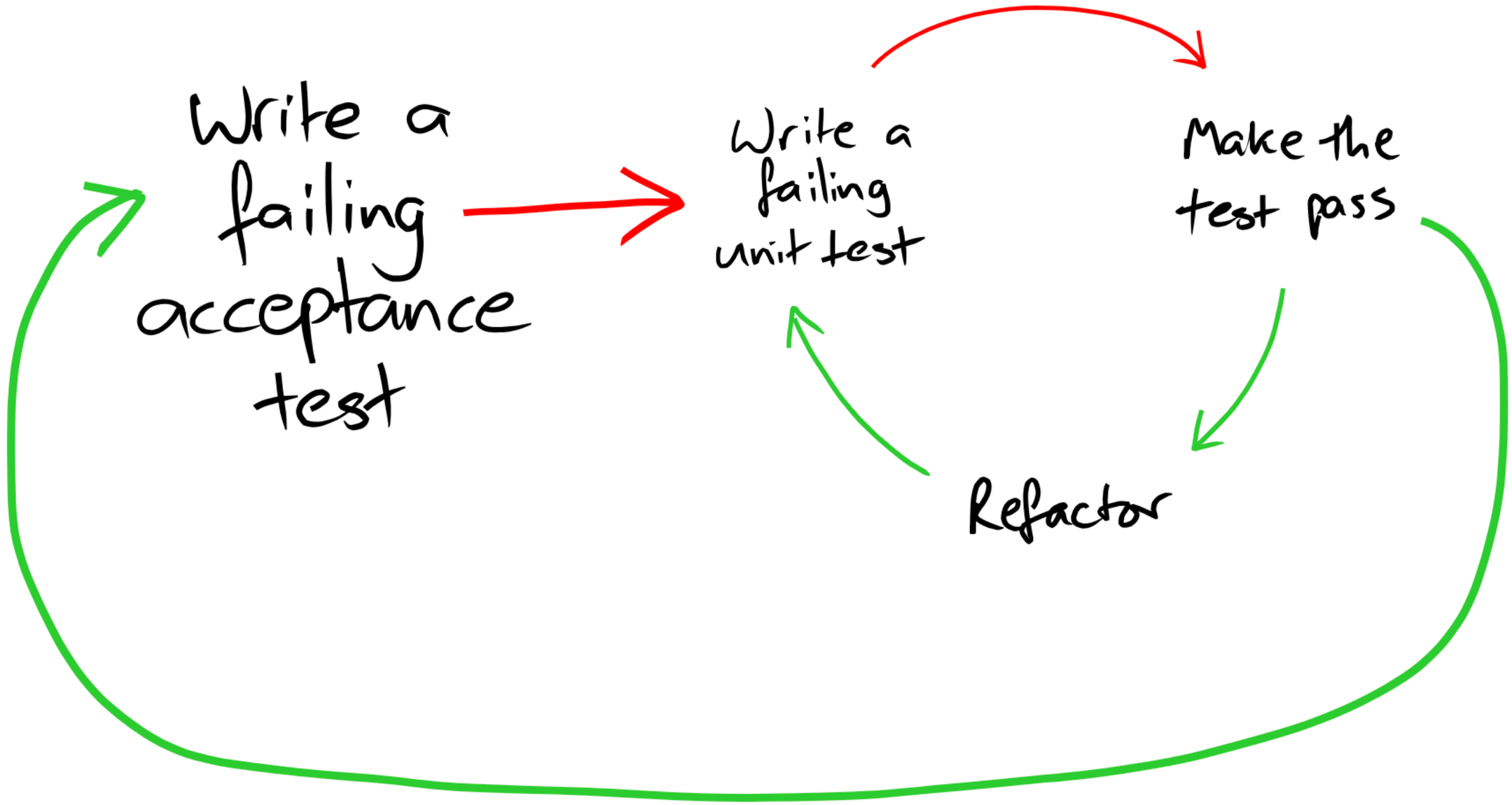
Improve TDD Cycle



Improve TDD Cycle



Acceptance tests

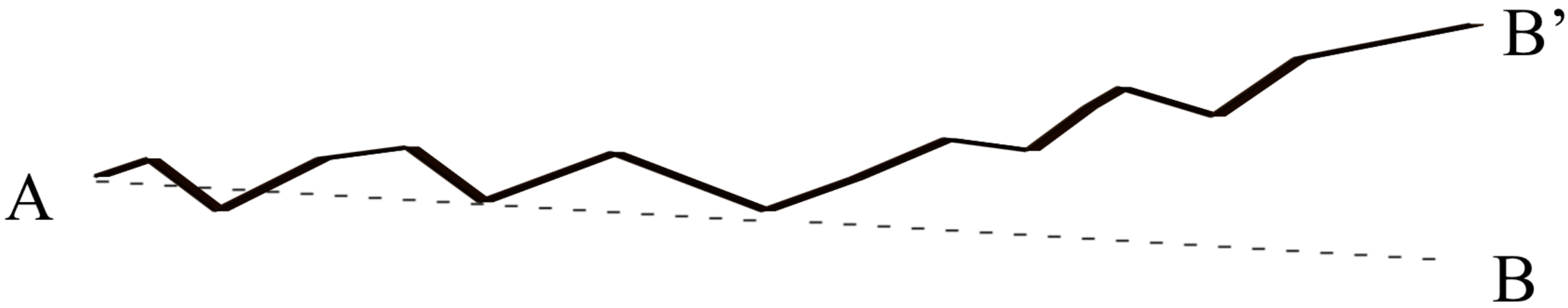


The Golden rule of TDD

"Never write a line of code without a failing test"

- Kent Beck -

Small Step



Learning Testing Tools

https://junit.org/junit5/

Build tools

Configure Gradle

```
dependencies {
    testImplementation(platform('org.junit:junit-bom:5.7.0'))
    testImplementation('org.junit.jupiter:junit-jupiter')
}

test {
    useJUnitPlatform()
    testLogging {
        events "passed", "skipped", "failed"
    }
}
```

JUnit 5 :: Test structure

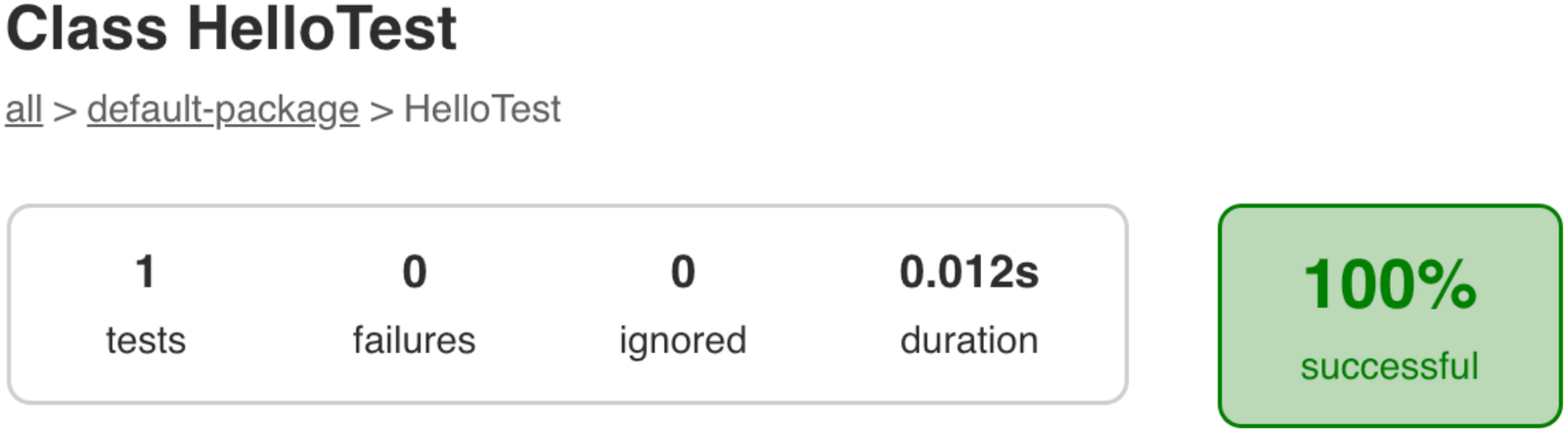
Using @Test and @DisplayName

```
import org.junit.jupiter.api.DisplayName;
import org.junit.jupiter.api.Test;

public class HelloTest {

    @Test
    @DisplayName("สวัสดี JUnit 5")
    public void testcase01() {

    }

}
```

Run test in command-line

$gradlew clean test

Open report in /build/reports/tests/test/index.html



Class HelloTest

all > default-package > HelloTest

1	0	0	0.012s
tests	failures	ignored	duration

100% successful

Tests

Test	Method name	Duration	Result
สวัสดี JUnit 5	testcase01()	0.012s	passed

Organize your tests

How to make your tests visually **consistent** ?

Keeping tests maintainable by testing **behavior**

The importance of **test naming**

Using **test's life cycle**

Good test structure

1. Setup the test data
2. Call your method under test
3. Assert that the expected results are returns

Good test structure

AAA (Arrange Act Assert)
Given When Then from BDD style

https://xp123.com/articles/3a-arrange-act-assert/
https://www.martinfowler.com/bliki/GivenWhenThen.html

Good test structure

Using Arrange-Act-Assert

```
public class HelloTest {

    @Test
    @DisplayName("สวัสดี JUnit 5")
    public void testcase01() {
        // Arrange
        Hello hello = new Hello();
        // Act
        String actualResult = hello.say("demo");
        // Assert
        assertEquals("Hello demo", actualResult);
    }

}
```

Assertion in JUnit 5

assertEquals/NotEquals

assertArrayEquals

assertTrue/False

assertNull/NotNull

assertSame/NotSame

assertThrows/DoesNotThrow

assertAll

Workshop

Input	Expected result
[1, 5]	1,2,3,4,5
[1, 5)	1,2,3,4
(1, 5]	2,3,4,5
(1, 5)	2,3,4

http://codingdojo.org/kata/Range/

Parameterized testing

Manage data for testing

```
public class DemoParameterizedTest {

    @ParameterizedTest(name = "sayHi with {0} is {1}")
    @CsvSource({
            "user 01,    Hello user 01",
            "user 02,    Hello user 02",
    })
    public void sayHi(String username, String expectedResult) {
        assertEquals(expectedResult, process(username));
    }

}
```

Parameterized testing

Manage data for testing

Class DemoParameterizedTest

all > default-package > DemoParameterizedTest

2	0	0	0.027s
tests	failures	ignored	duration

100%
successful

Tests

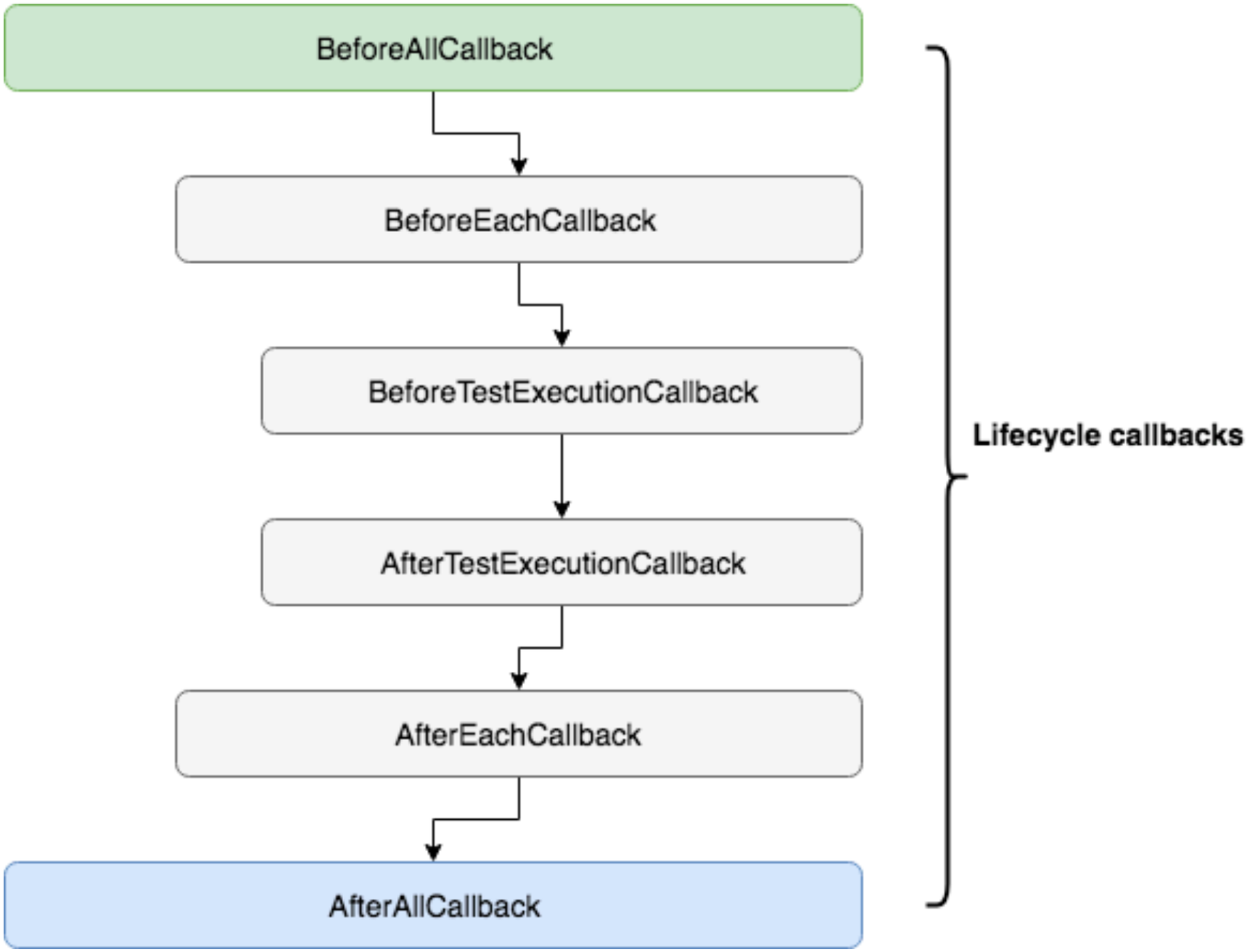
Test	Method name	Duration	Result
sayHi with user 01 is Hello user 01	sayHi(String, String)[1]	0.026s	passed
sayHi with user 02 is Hello user 02	sayHi(String, String)[2]	0.001s	passed

Working with Exceptions

Using assertThrows/DoesNotThrow

```
@Test
@DisplayName("throws SomException when called hi")
void throwsExceptionWhenCalledHi() {

    Hello hello = new Hello();
    SomeException exception =
            assertThrows(SomeException.class, () ->
                    hello.say("error")
    );

    assertEquals(exception.getMessage(), "Some exception");

}
```

Testing life-cycle



Testing life-cycle

```
public class DemoLifeCycleTest {

    @BeforeAll
    public static void setup() {
        System.out.println("Call setup");
    }
    @AfterAll
    public static void teardown() {
        System.out.println("Call teardown");
    }
    @BeforeEach
    public void setupBeforeTest() {
        System.out.println("Call setupBeforeTest");
    }
    @AfterEach
    public void teardownAfterTest() {
        System.out.println("Call teardownAfterTest");
    }
}
```

Code coverage

"Code coverage can show the high risk areas in a program, but never the risk-free."

Paul Reilly, 2018, Kotlin TDD with Code Coverage

Code coverage

A tool to measure how much of your code is covered by tests that break down into classes, methods and lines.

Code coverage

Hello.java

```
1. public class Hello {
2.     public String say(String demo) {
3.         if(demo == null) {
4.             throw new SomeException();
5.         }
6.         return "Hello " + demo;
7.     }
8.
9. }
```

Code coverage

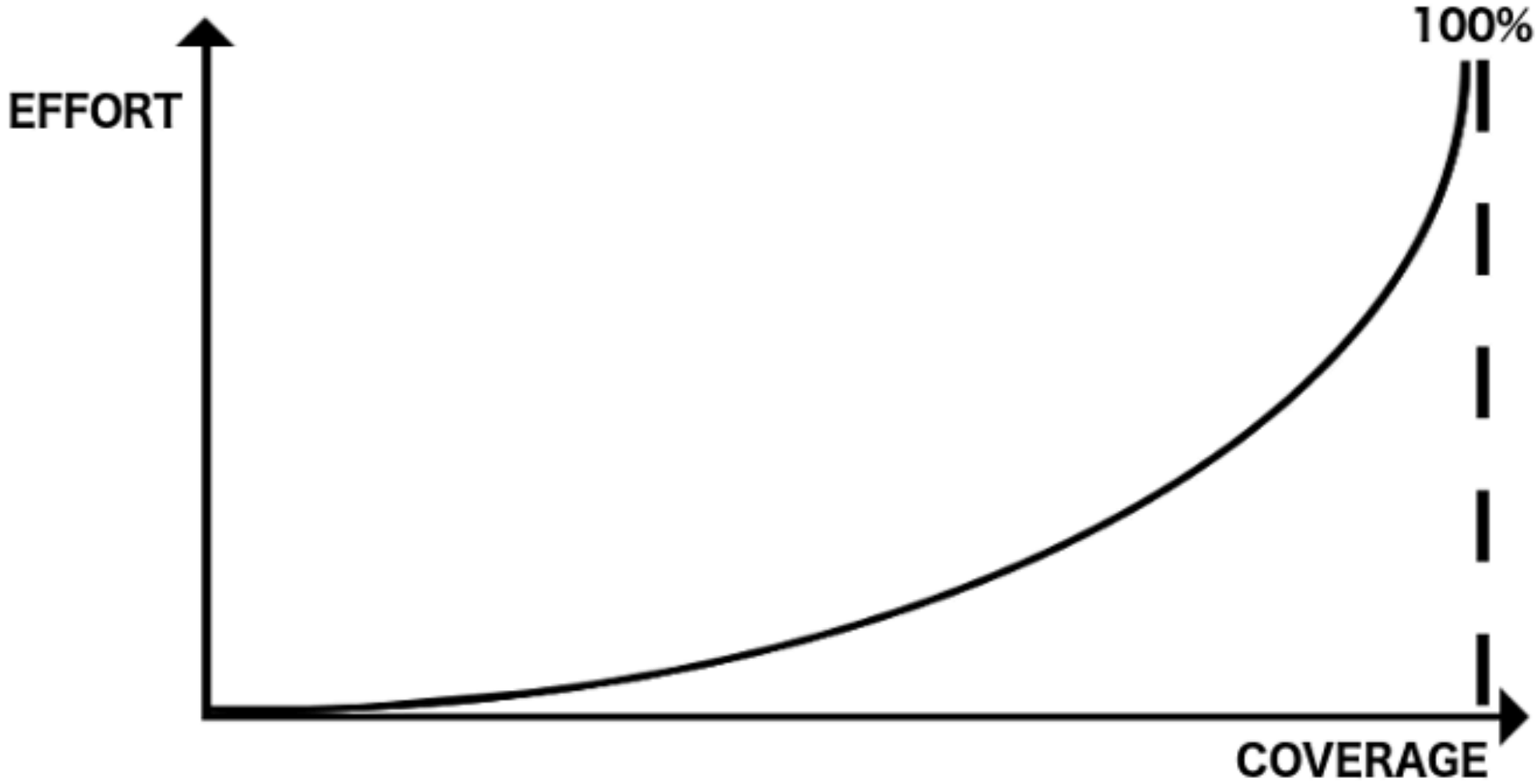
But 100% of code coverage **does not mean** that your code is 100% correct

Code coverage

Powerful tool to improve the quality of your code

Code coverage != quality of tests

Code coverage 100% ?



Using Jacoco

JaCoCo

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods	Missed	Classes
org.jacoco.examples		58%		64%	24	53	97	193	19	38	6	12
org.jacoco.core		97%		93%	107	1,388	115	3,347	21	720	2	139
org.jacoco.agent.rt		77%		84%	31	121	62	310	21	74	7	20
jacoco-maven-plugin		90%		81%	35	183	44	407	8	110	0	19
org.jacoco.cli		97%		100%	4	109	10	275	4	74	0	20
org.jacoco.report		99%		99%	4	572	2	1,345	1	371	0	64
org.jacoco.ant		98%		99%	4	163	8	429	3	111	0	19
org.jacoco.agent		86%		75%	2	10	3	27	0	6	0	1
Total	1,355 of 27,352	95%	143 of 2,125	93%	211	2,599	341	6,333	77	1,504	15	294

https://www.eclemma.org/jacoco/

Configure Jacoco with Gradle

Edit file build.gradle

```
apply plugin: "jacoco"
jacoco {
    toolVersion = '0.7.9'
}

jacocoTestReport {
    reports {
        xml.enabled = true
        html.enabled = true
    }
}
```

Run code coverage

$gradlew jacocoTestReport

Open report in build/reports/jacoco/test/html/index.html

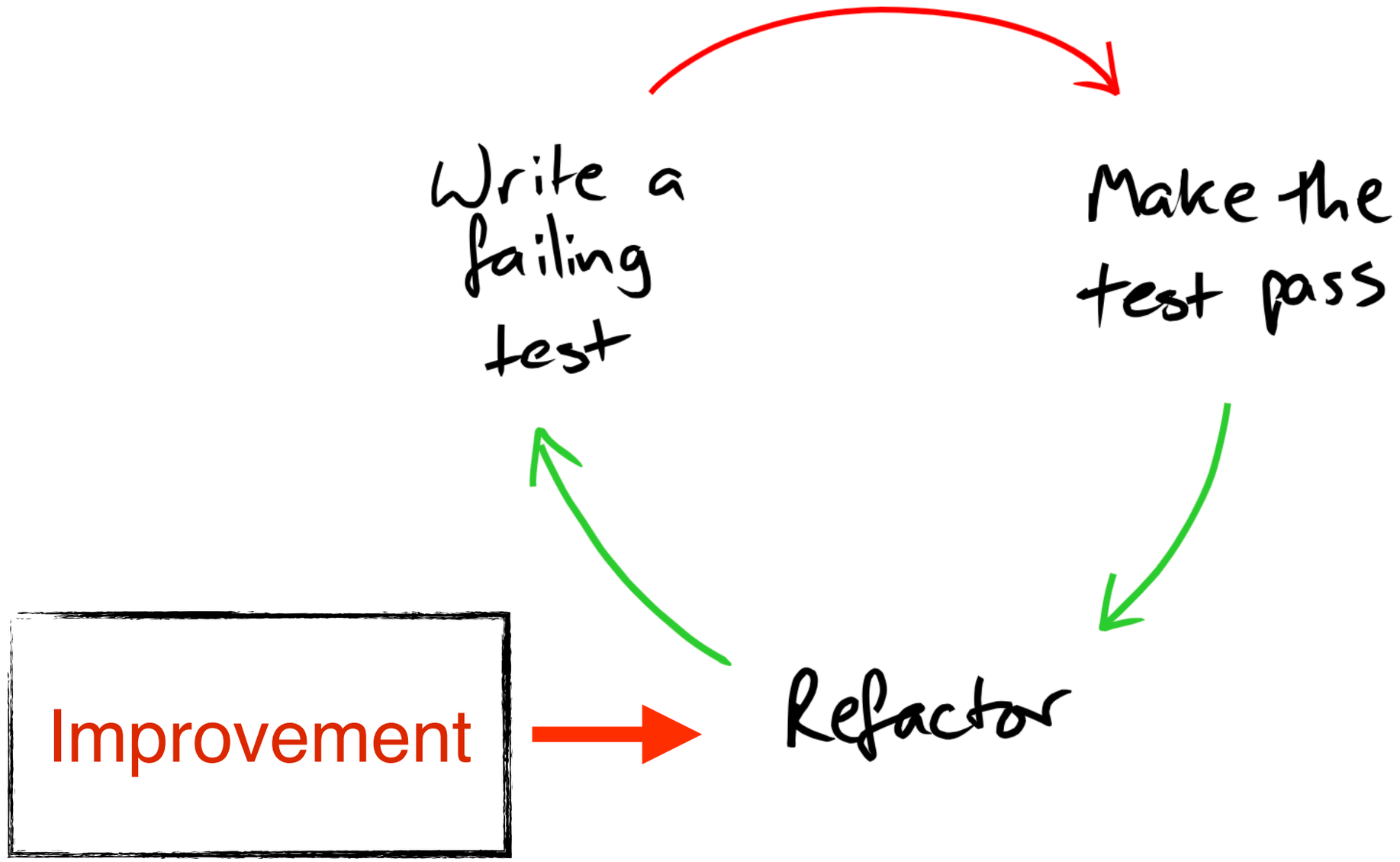
demo-junit5 > default

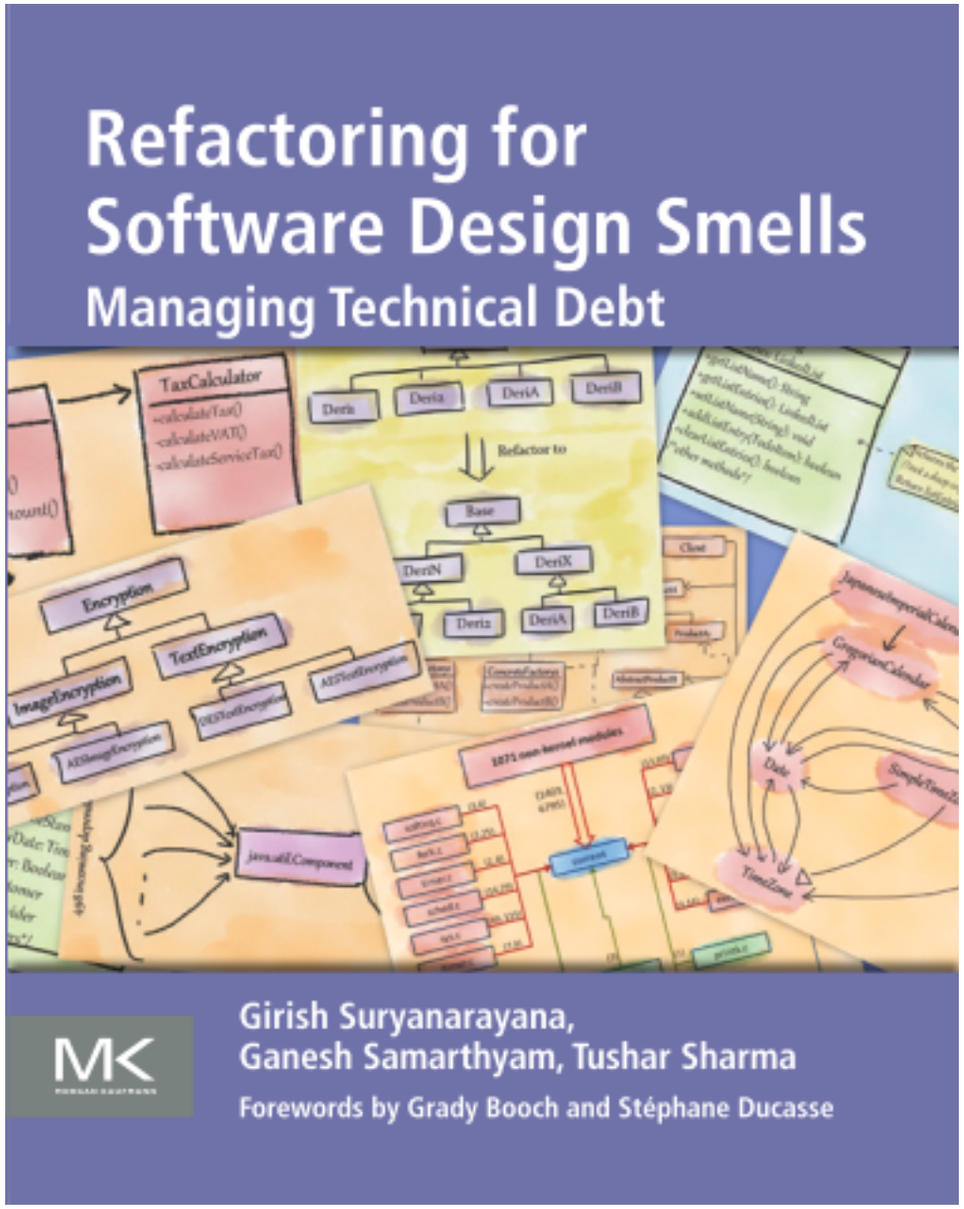
default

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty
SomeException		0%		n/a	1	1
Hello		100%		n/a	0	2
Total	3 of 15	80%	0 of 0	n/a	1	3

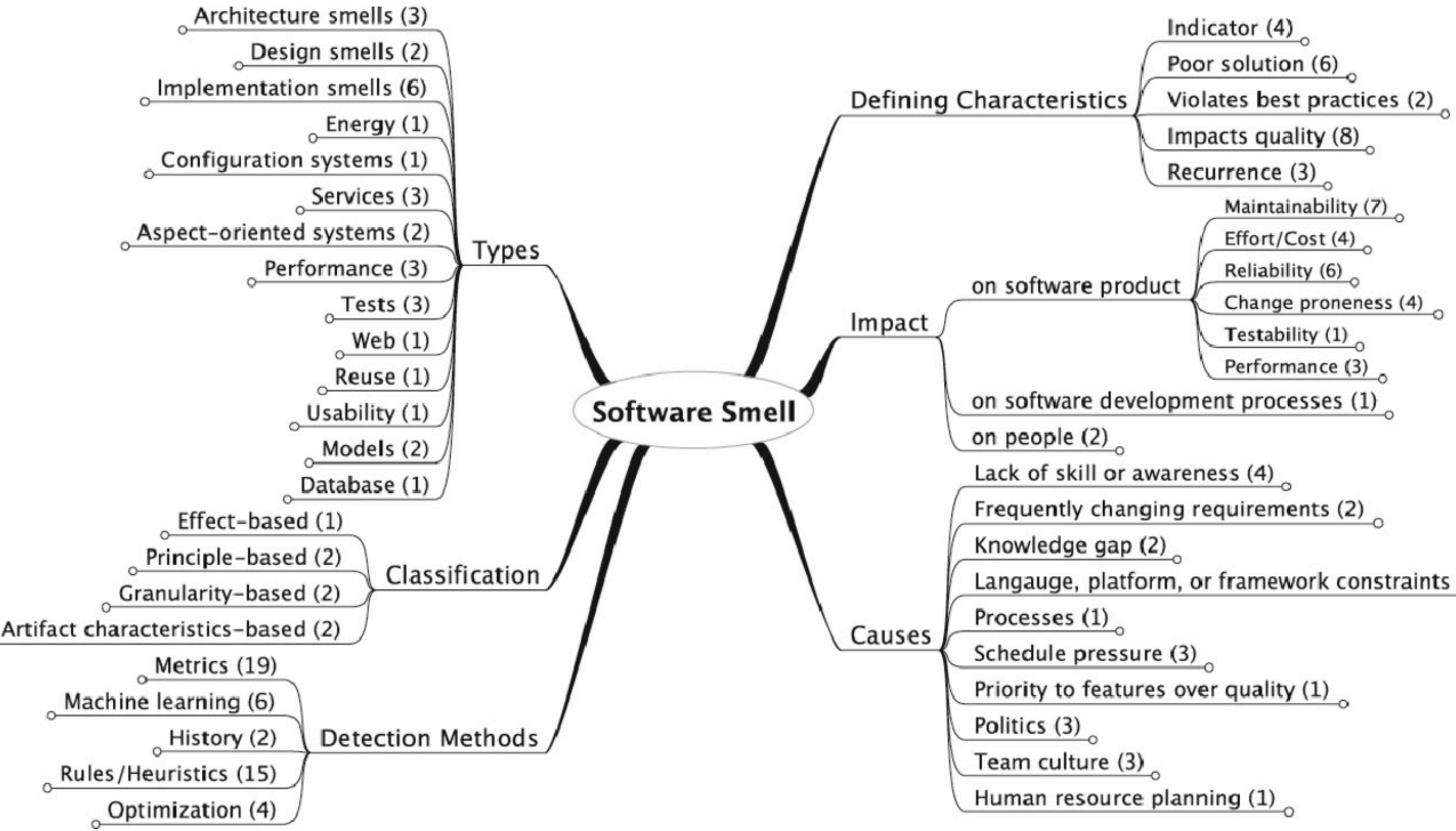
Don’t forgot Refactoring

Improve TDD Cycle





http://www.tusharma.in/smells/



https://www.sciencedirect.com/science/article/pii/S0164121217303114

Code Smell

Code Smells

– What? How can code "smell"??

– Well it doesn't have a nose... but it definitely can stink!

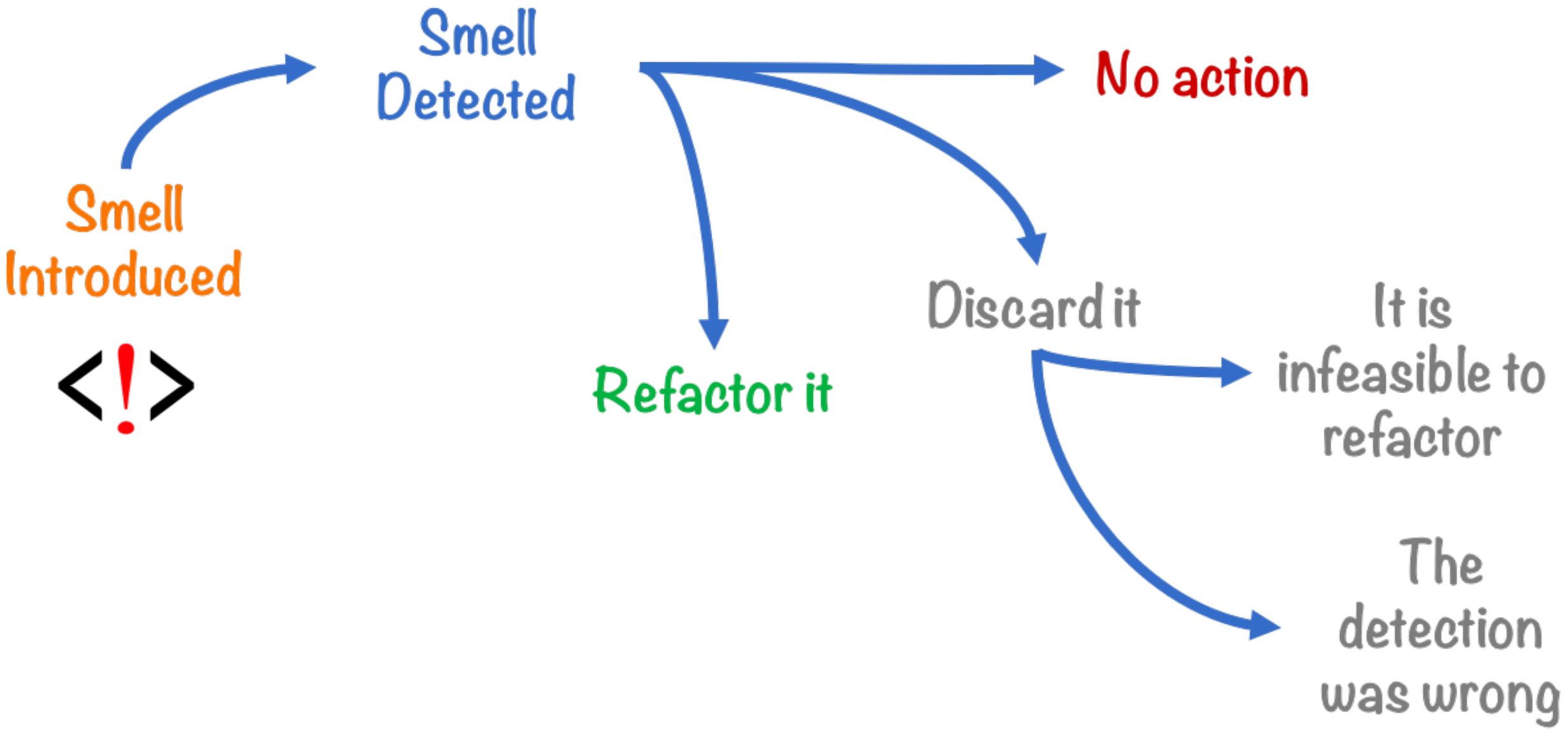
Bloaters

Bloaters are code, methods and classes that have increased to such gargantuan proportions that they are hard to work with. Usually these smells do not crop up right away, rather they accumulate over time as the program evolves (and especially when nobody makes an effort to eradicate them).

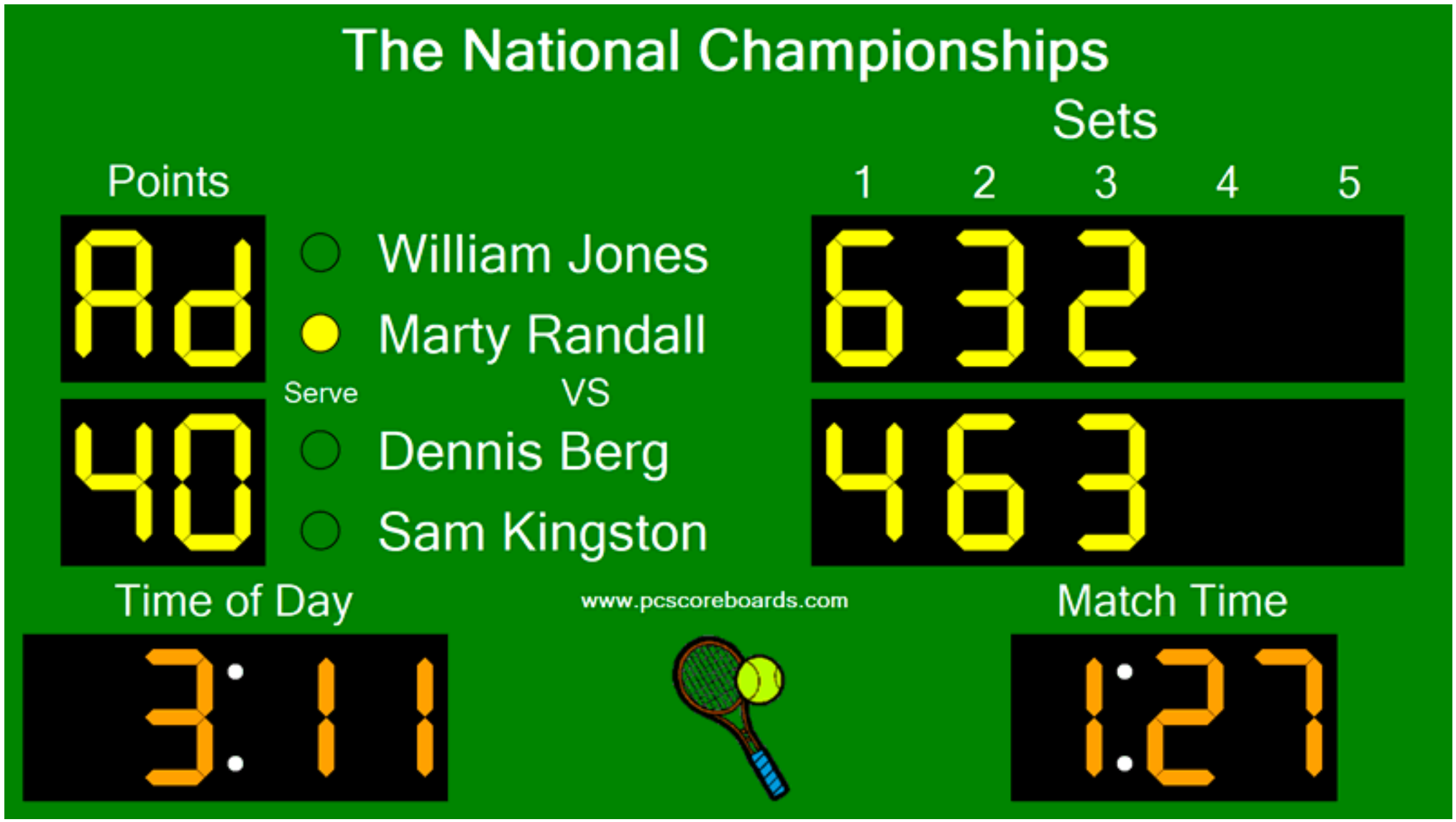
- Long Method
- Large Class
- Primitive Obsession
- Long Parameter List
- Data Clumps

https://sourcemaking.com/refactoring/smells

Life-cycle of a smell



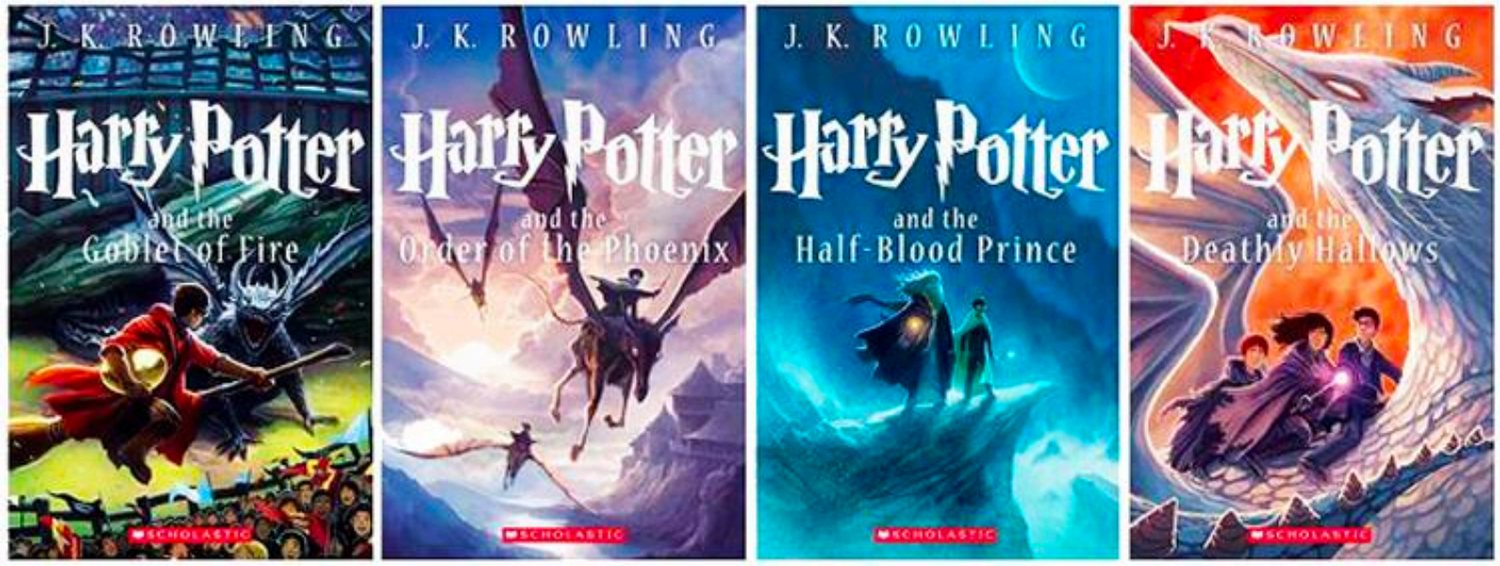
Workshop



https://codingdojo.org/kata/Tennis/

Test as Design

Workshop



http://codingdojo.org/kata/Potter/

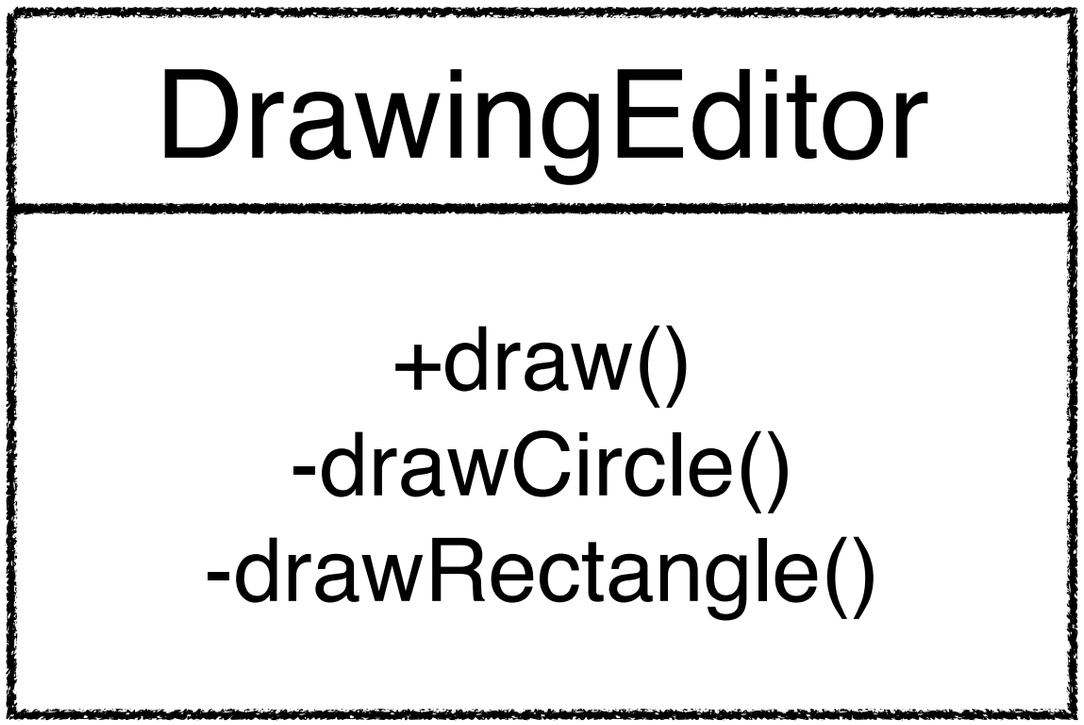
S.O.L.I.D principles

S.O.L.I.D

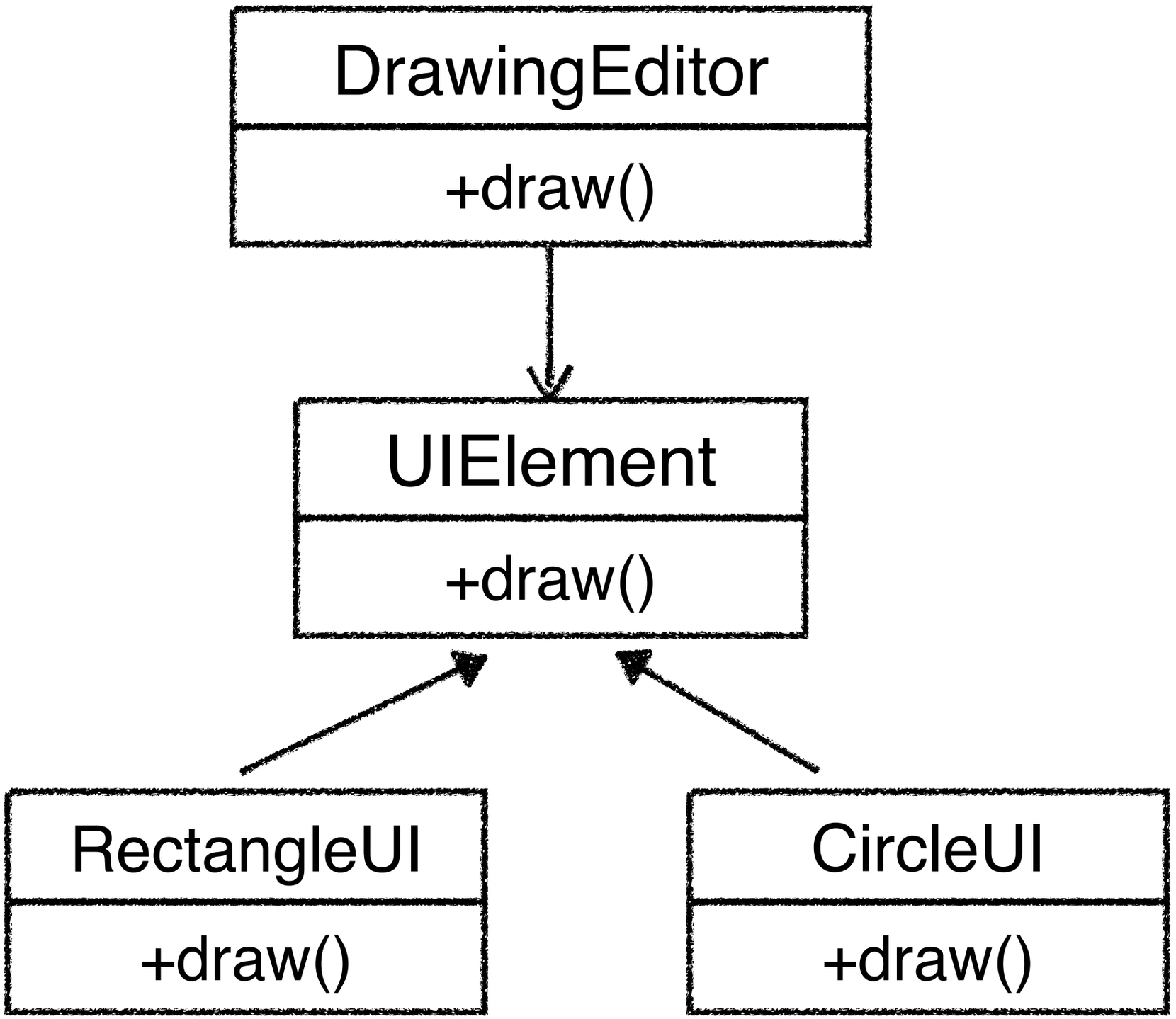
Single Responsibility Principle

Open-Closed Principle

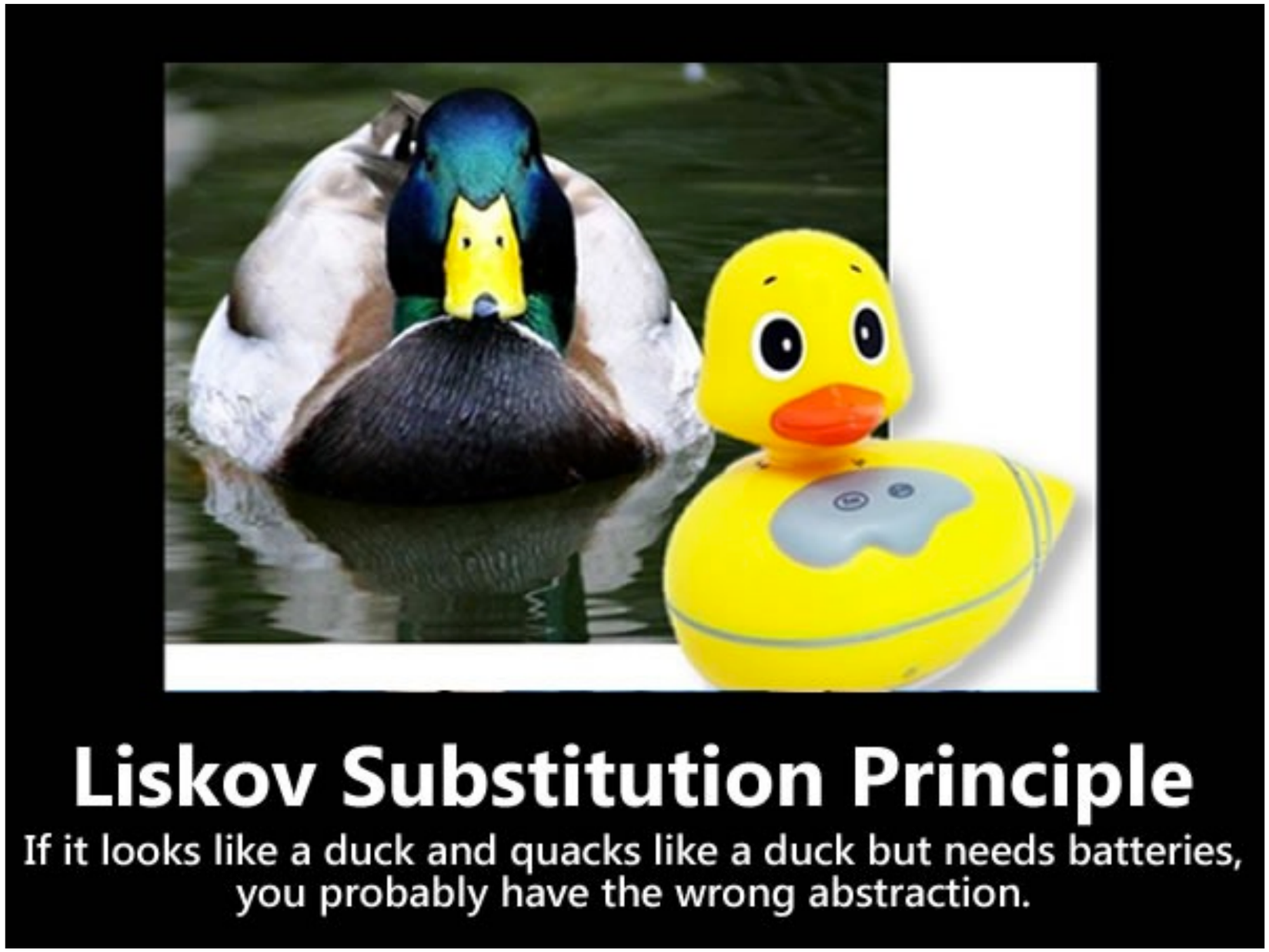
Example



Example

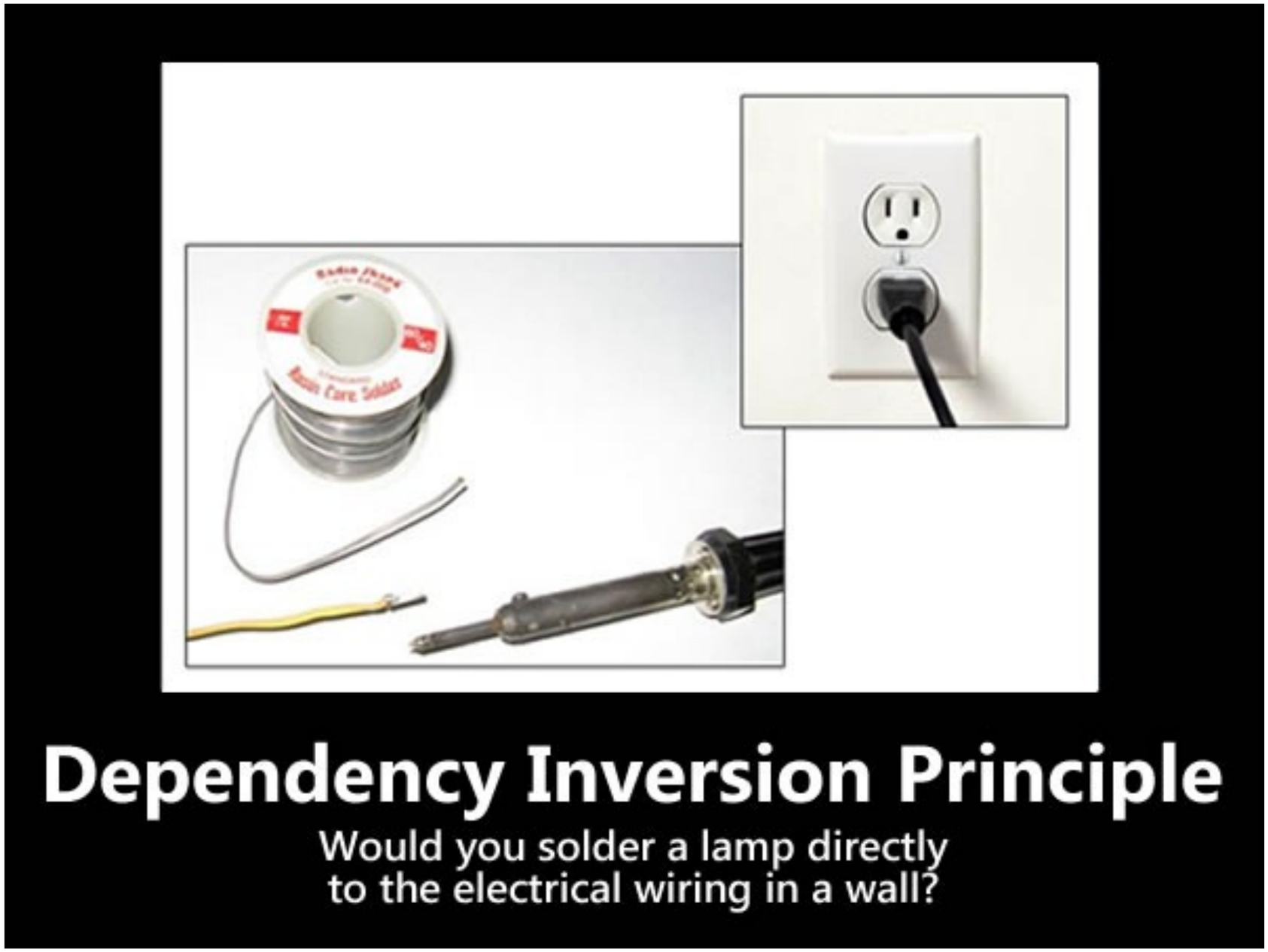


Liskov Substitution Principle



Interface Segregation Principle

Dependency Inversion Principle

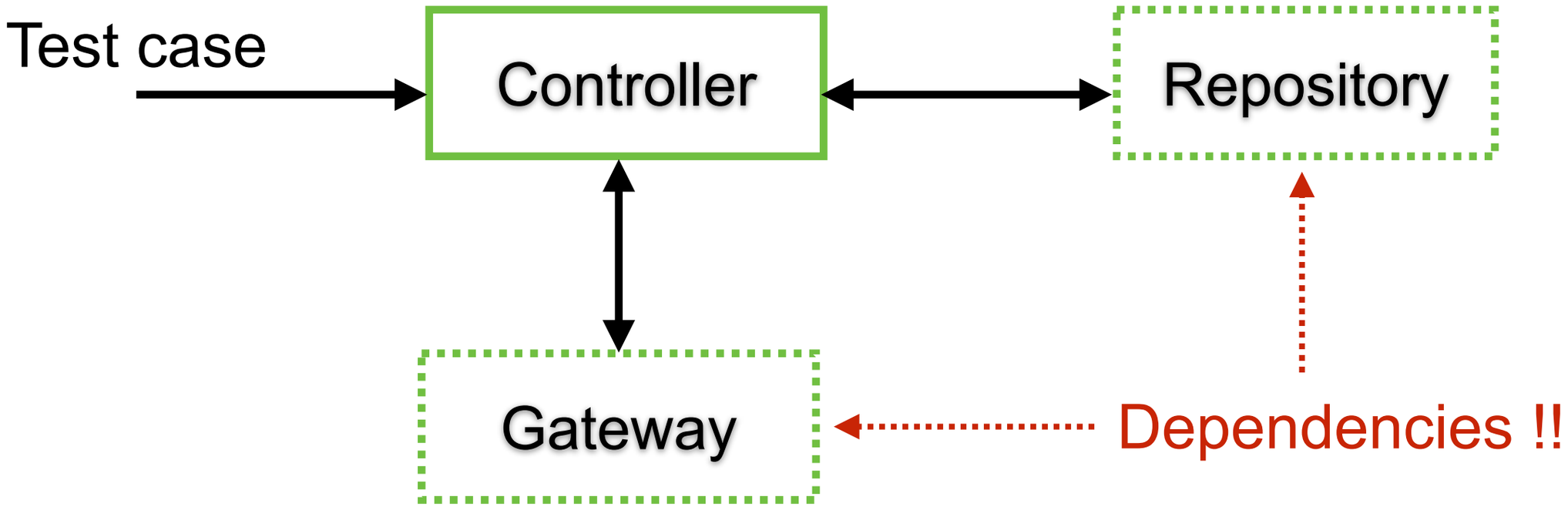


Manage your dependencies

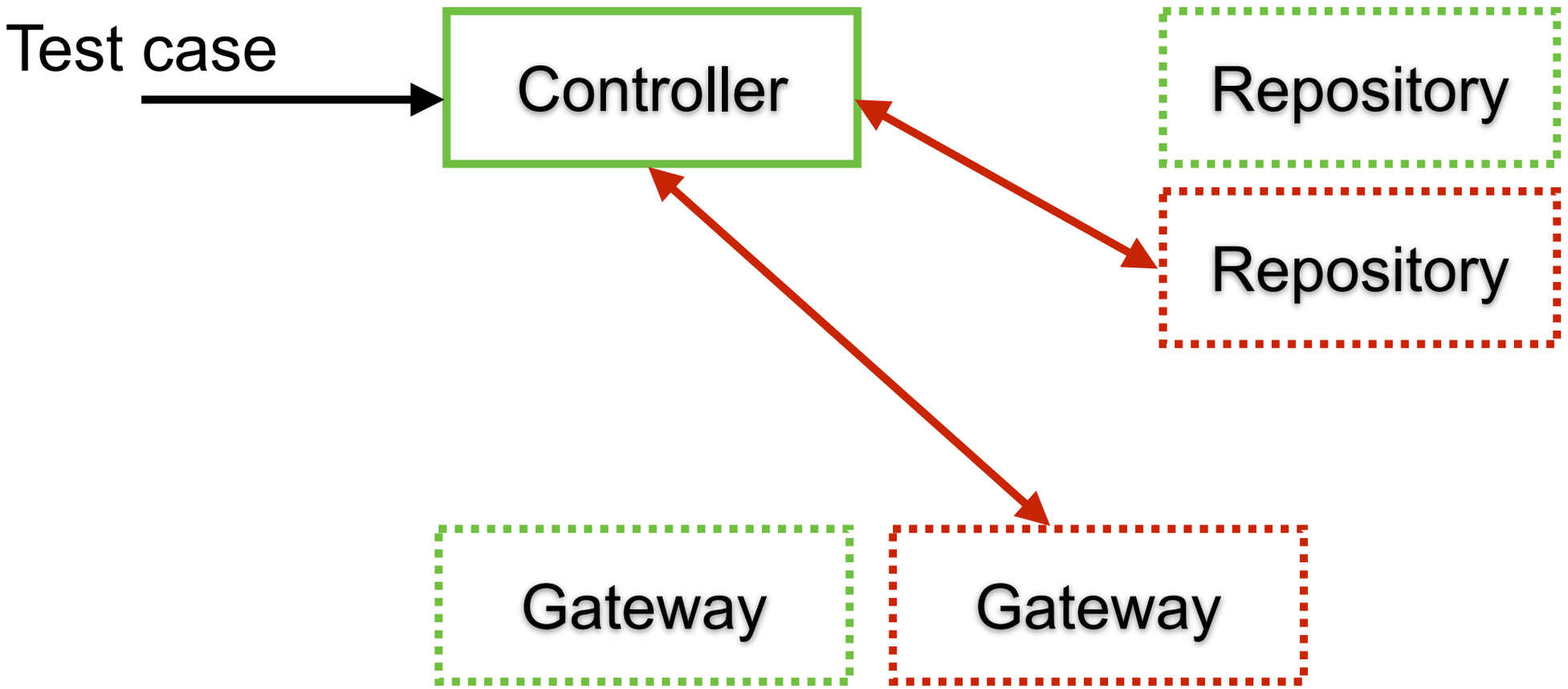
Good Unit Tests (F.I.R.S.T)

Fast
Independent/Isolate
Repeat
Self-validate
Thorough/Timely

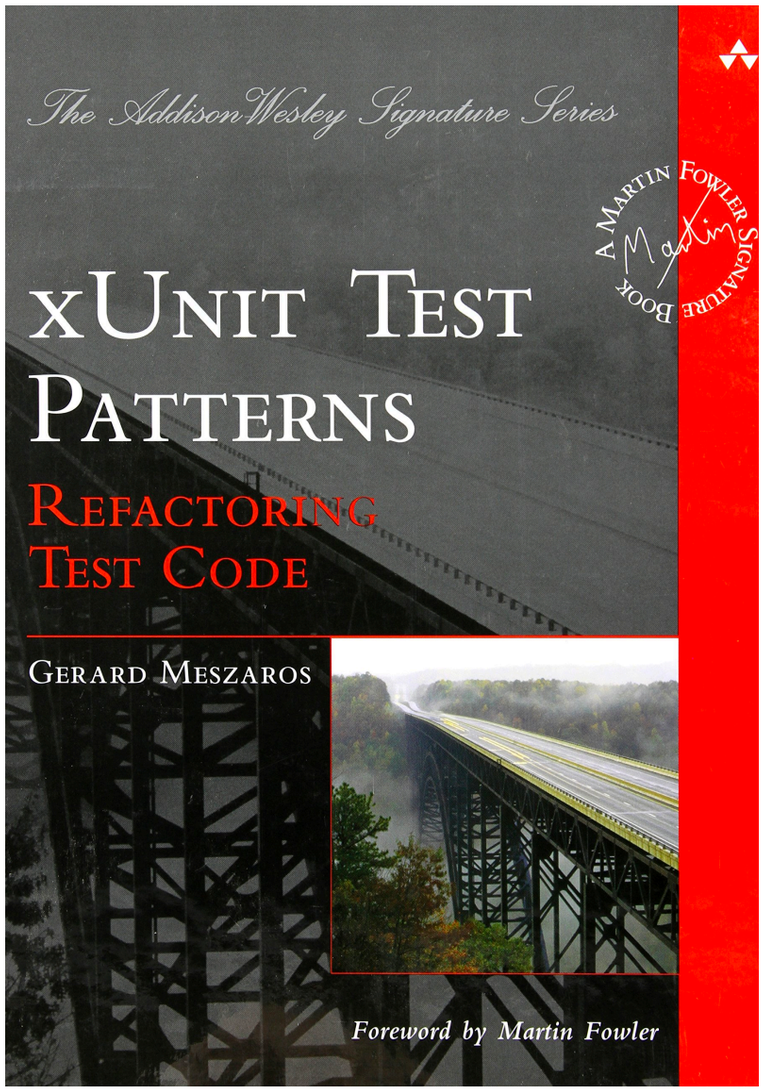
How to test Controller ?



Working with dependencies



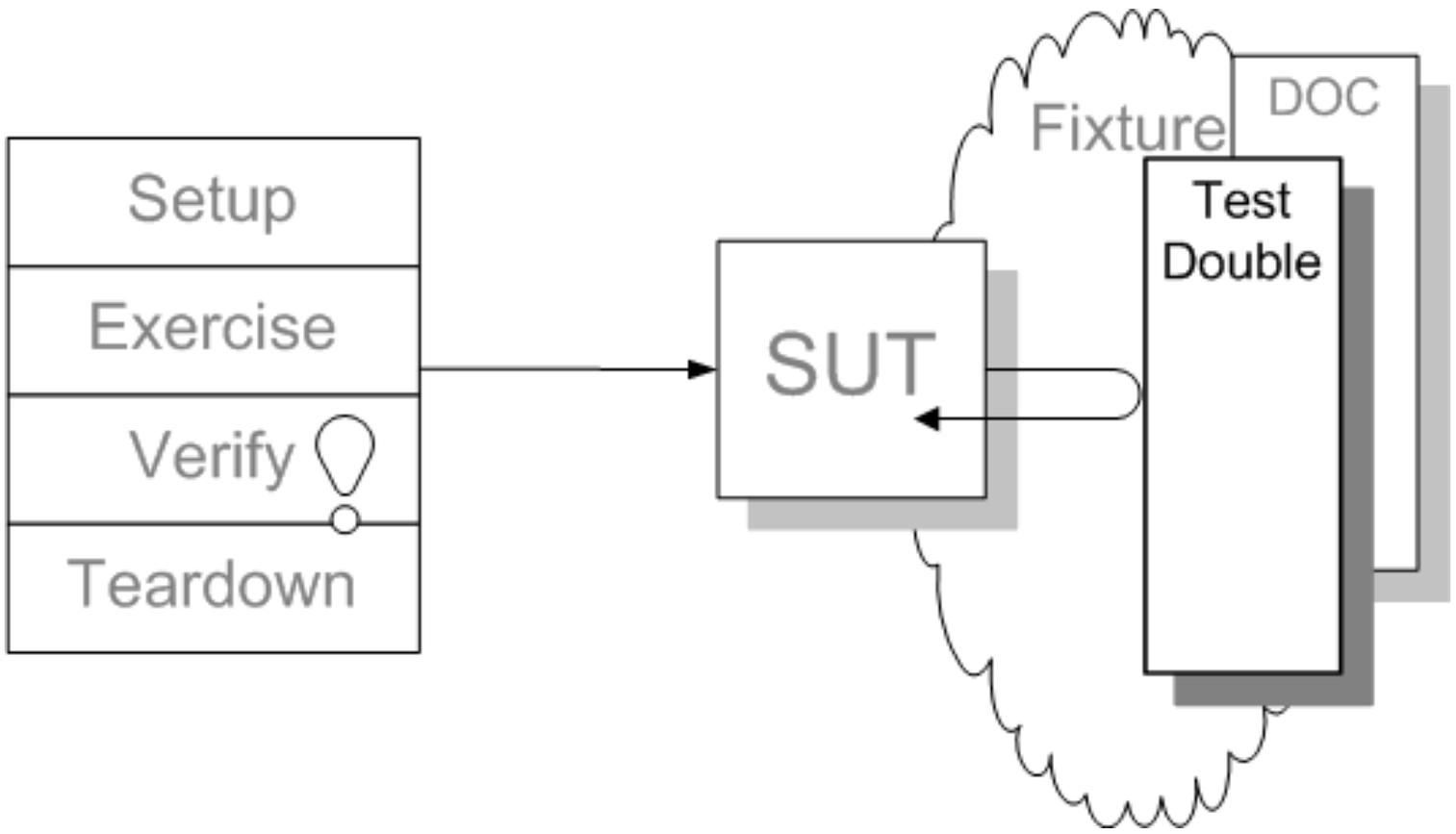
Test double ?



http://xunitpatterns.com

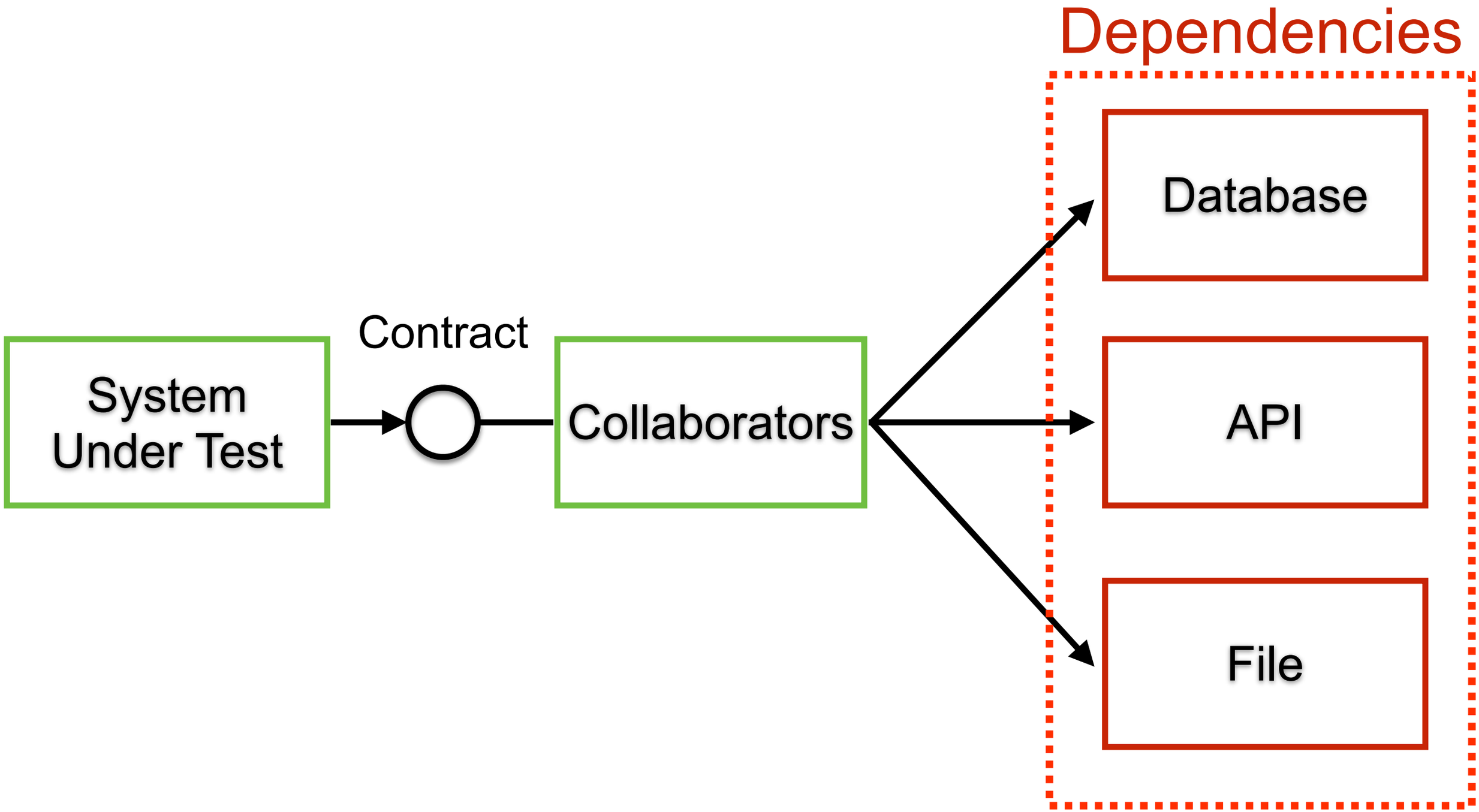
Test double ?

Stand-in for something that would be otherwise real in the execution of your program

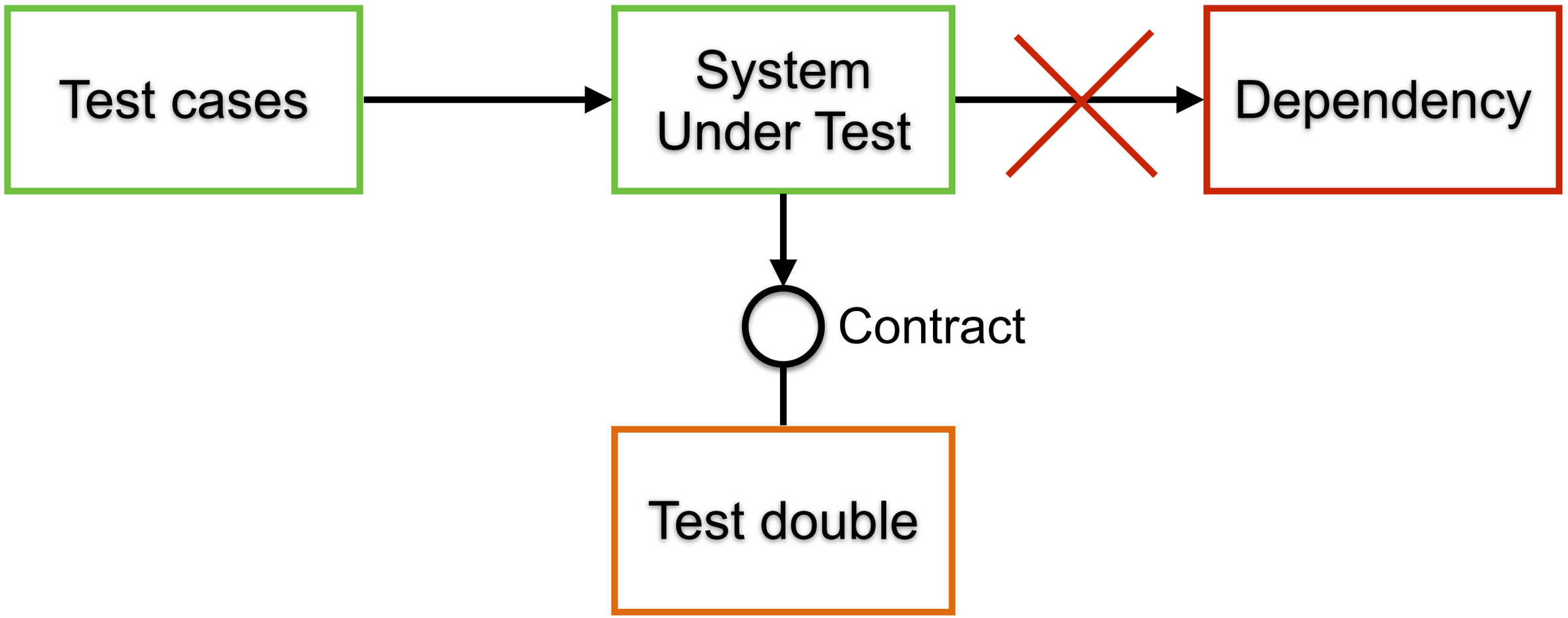


http://xunitpatterns.com/Test%20Double.html

Real implementation



With Test double



Types of Test double

Dummy object	Stub	Spy	Mock object	Fake object

Types of Test double

Dummy object

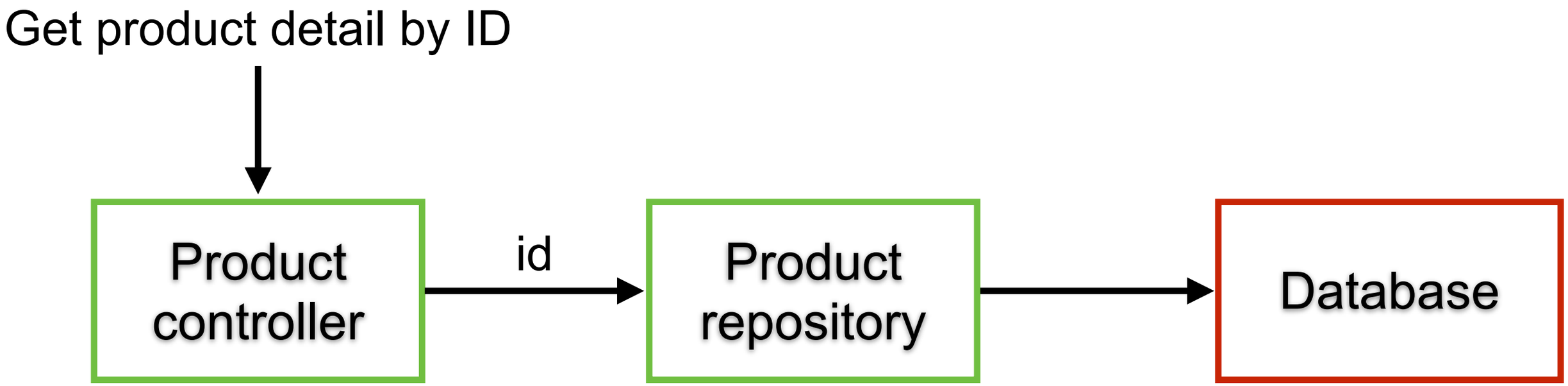
Stub

Fake object

Spy

Mock object

Example



Fake

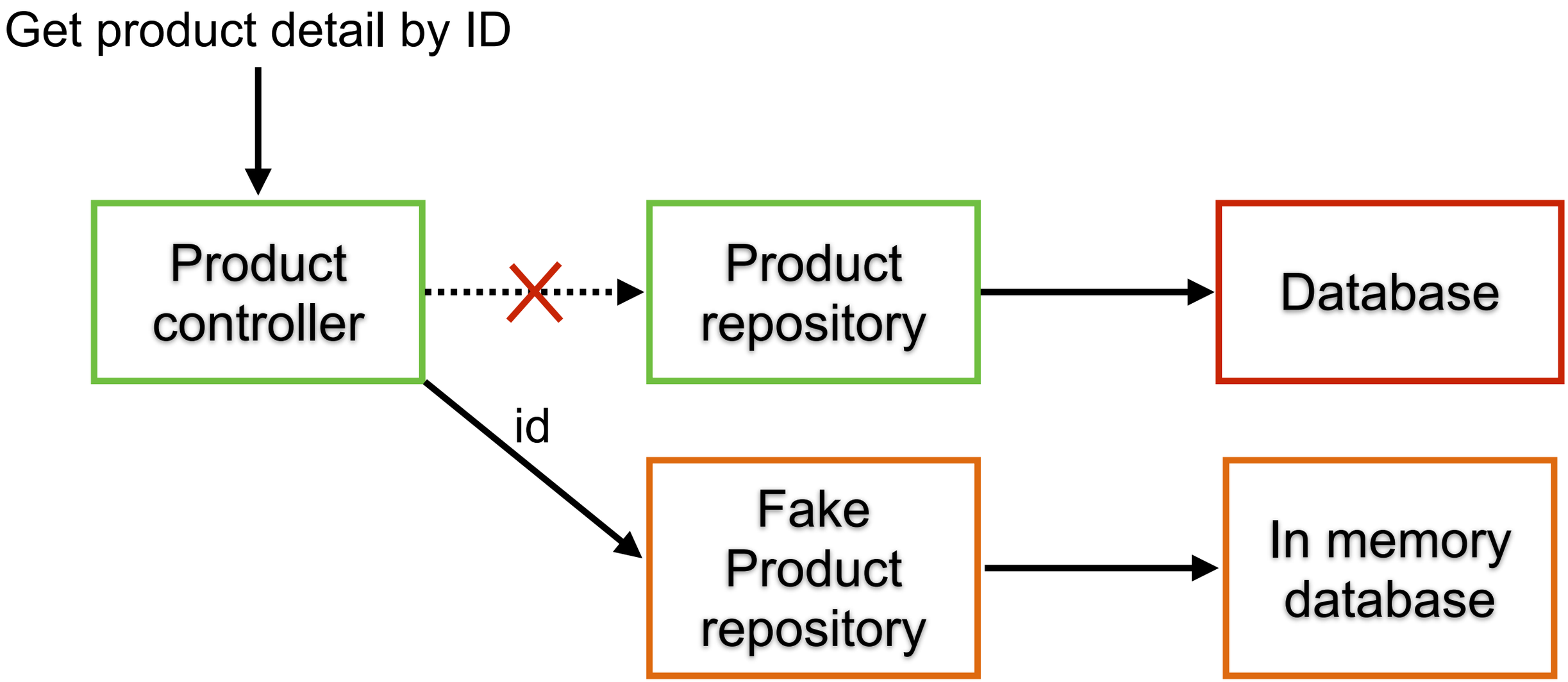
Working with implementation but take some shortcut

Not suitable for production

Use with read and write operations

E.g. In-memory database, Fake API server

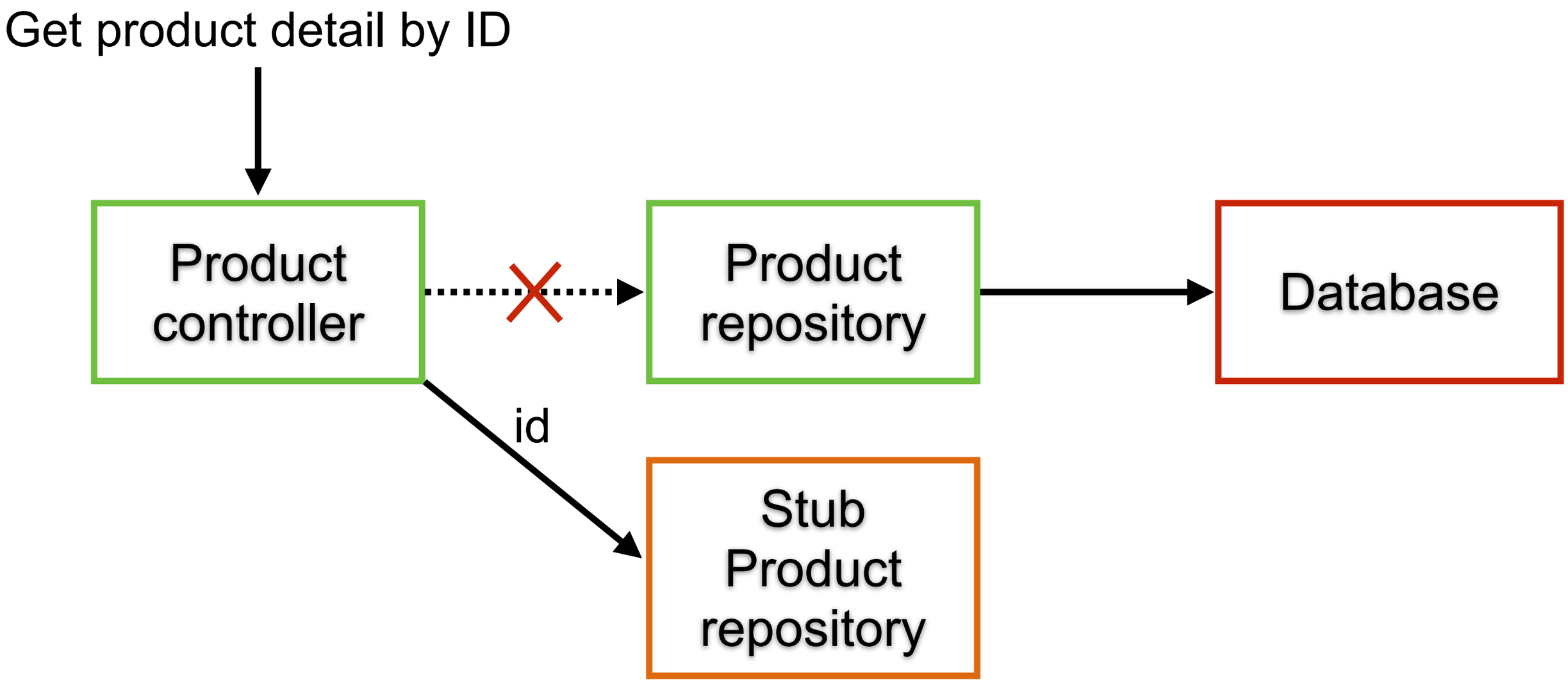
Fake



Stub

Provide answers to calls made during the test
A double with hardcode return values

Stub

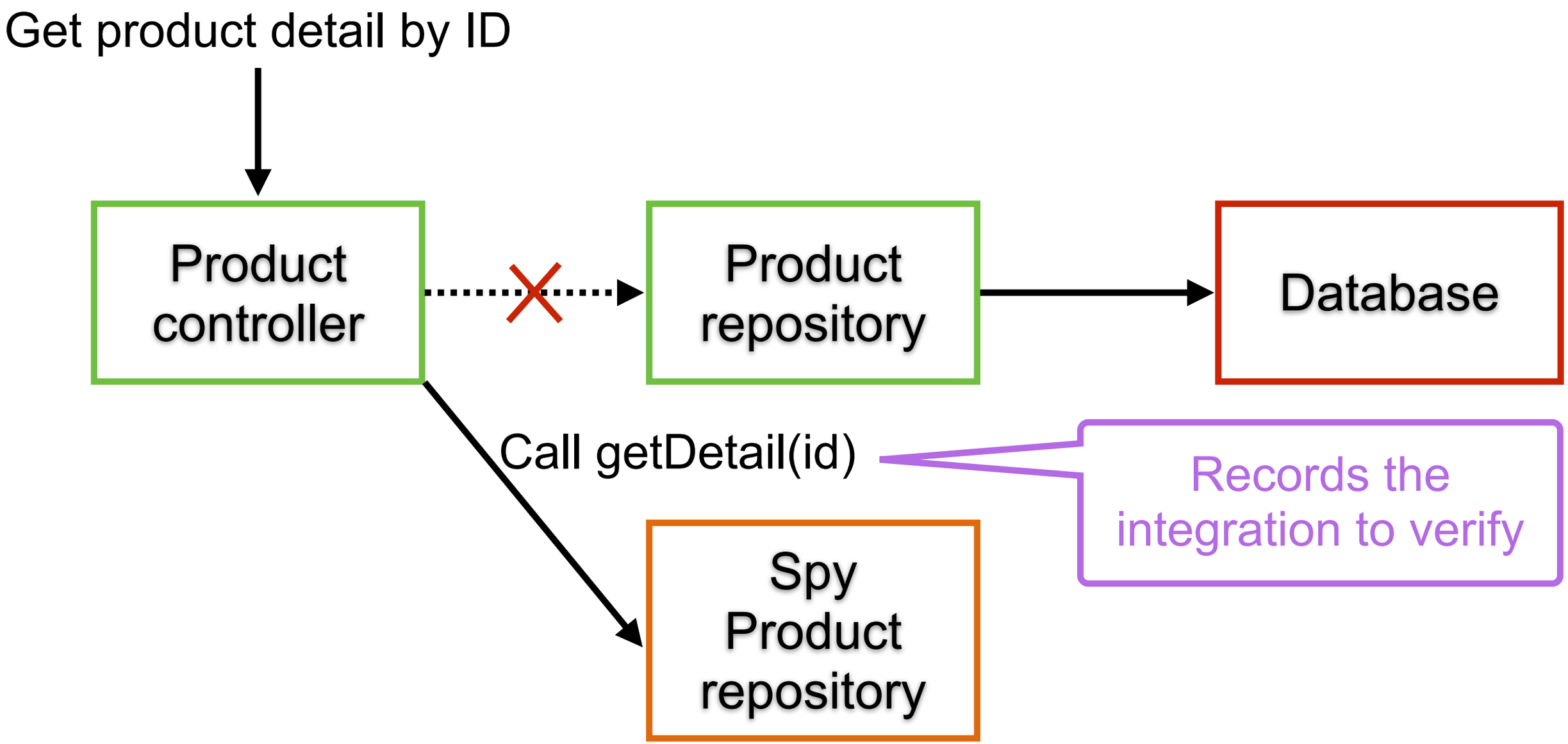


Spy

Like stub
Record some information based on how its called

E.g. how many message it was sent via email service

Spy

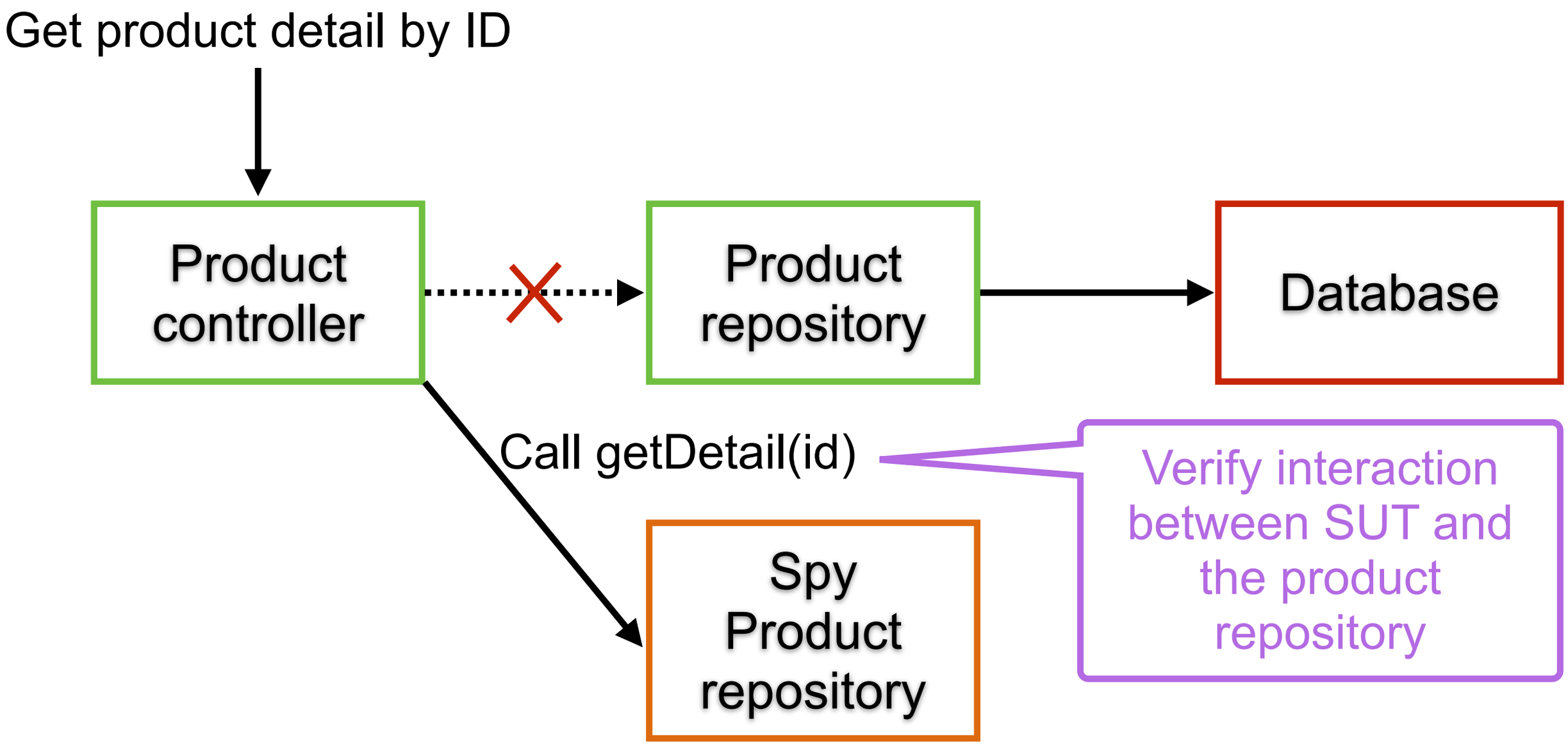


Mock object

Pre-programmed with expectations with spec

Mock object can throw an exception if receive a call that don’t expect

Mock object

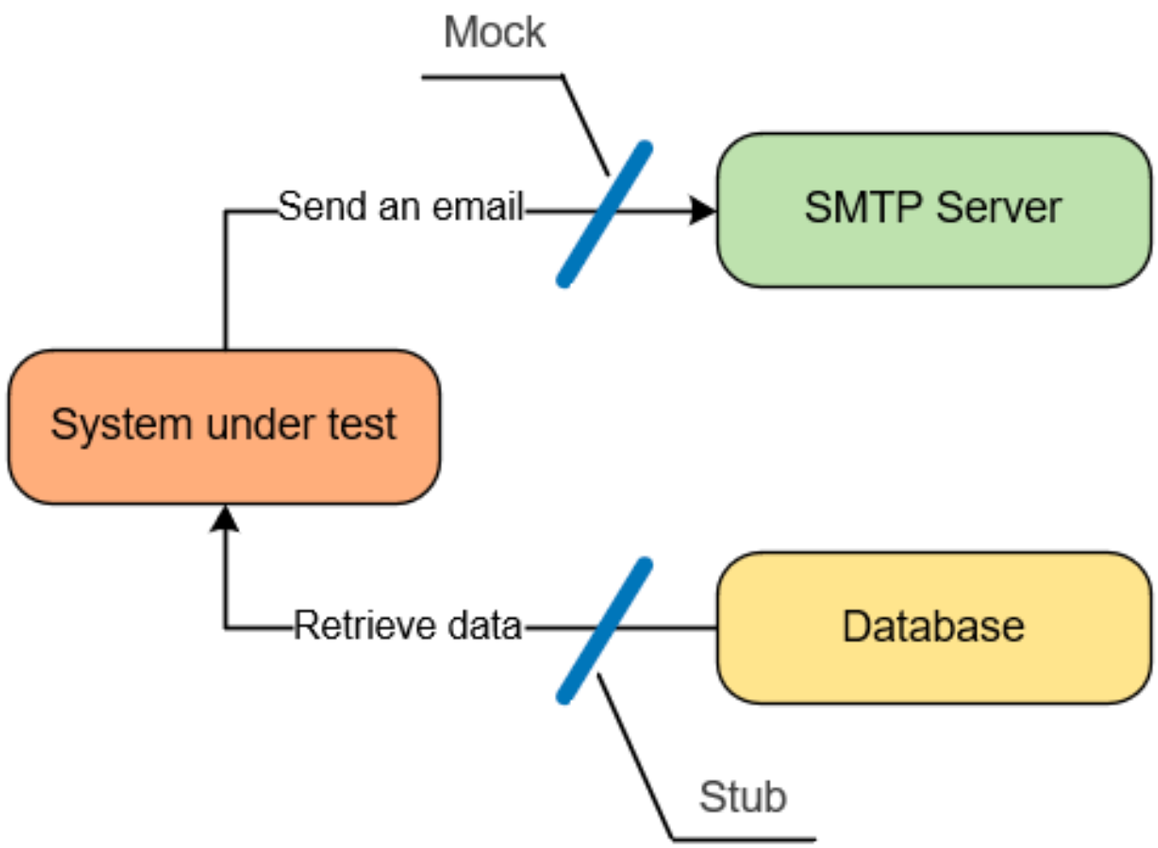


Dummy object

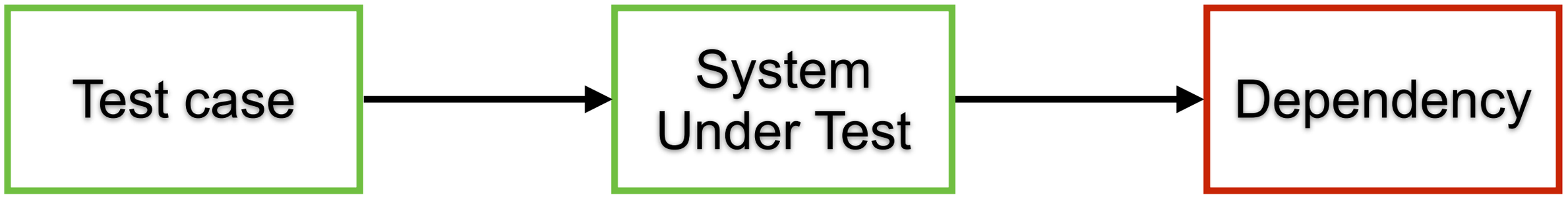
Passed around but never actually used
Used to fill parameter lists

Mock vs Stub

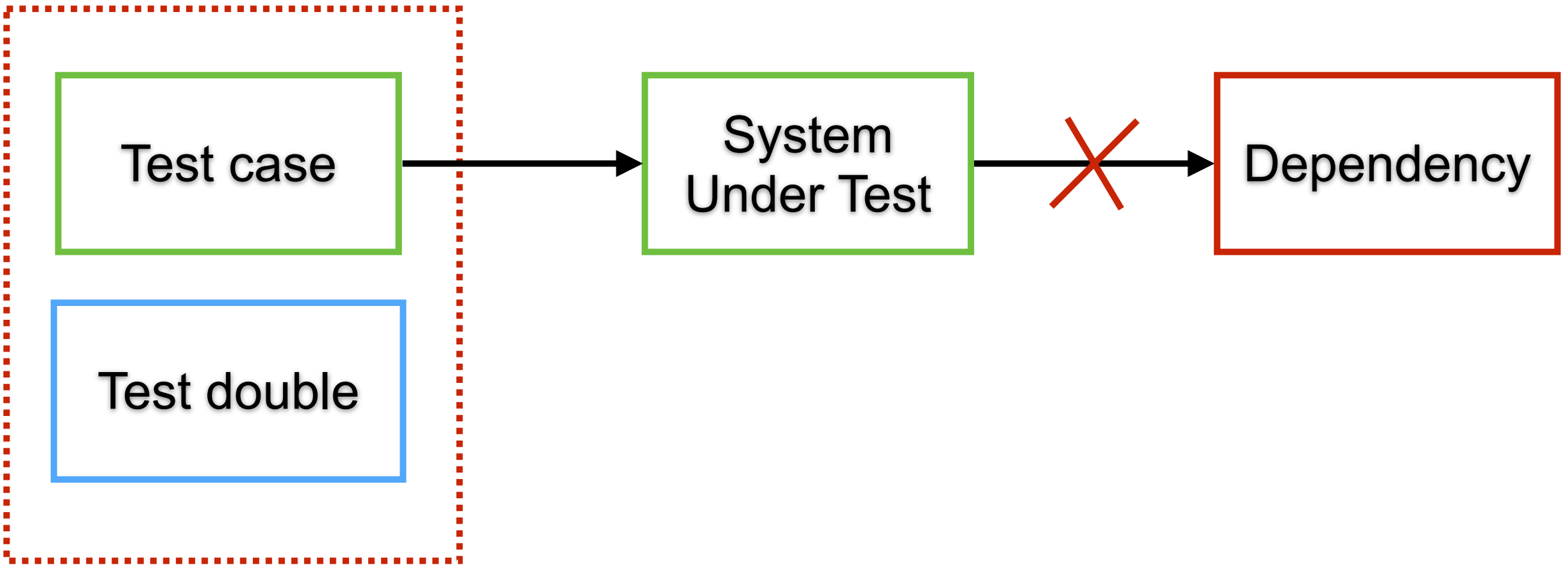
Mock for outcoming interaction
Stub for incoming interaction



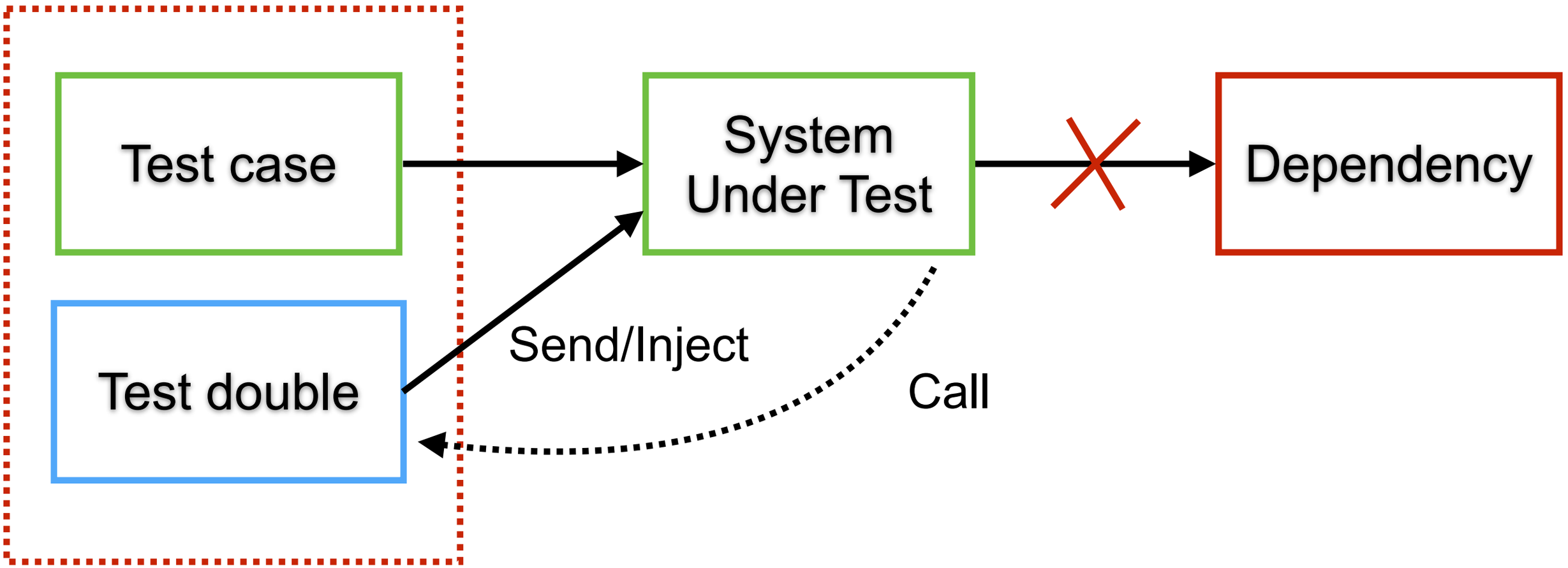
Test double ?



Create test double

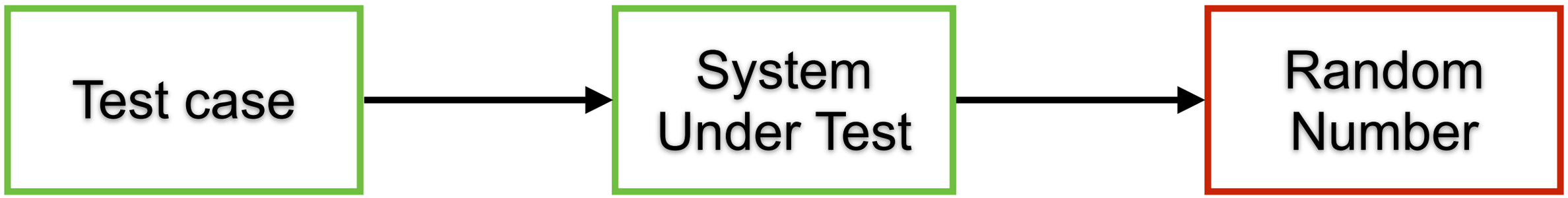


Send/inject test double to SUT

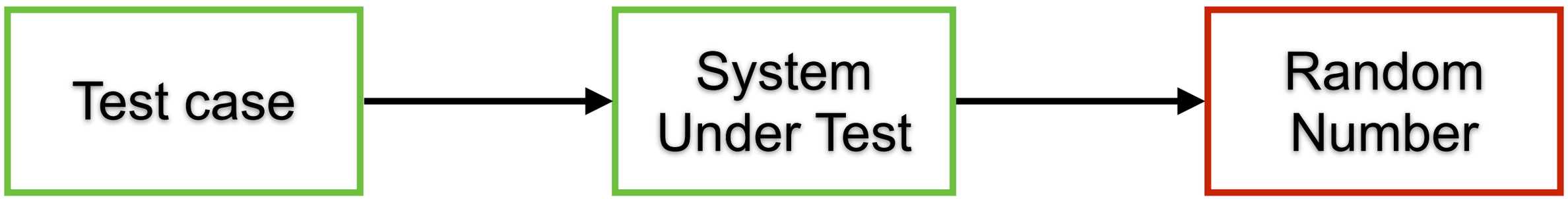


Workshop

Workshop

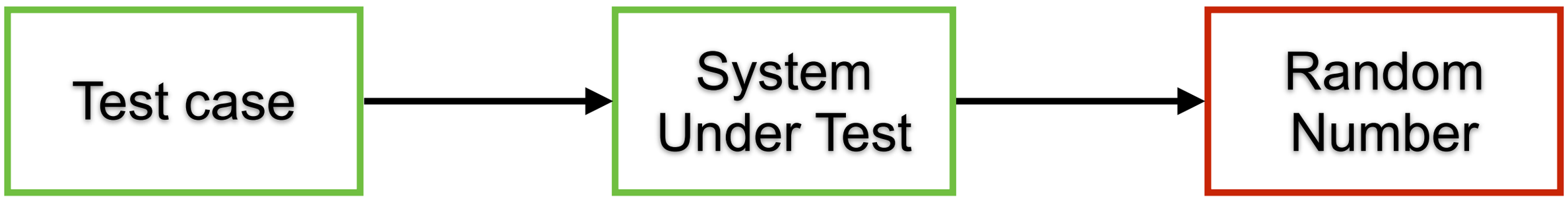


Workshop



Test random number = 5 ?

Workshop



Test random number must called 1 time ?

Working with Mockito

https://site.mockito.org/

Configure Mockito with Gradle

Edit file build.gradle

```
dependencies {
    …
 testImplementation "org.mockito:mockito-core:3.6.0"
 testImplementation "org.mockito:mockito-junit-jupiter:3.6.0"

    …
}
```

Using Mockito with JUnit 5

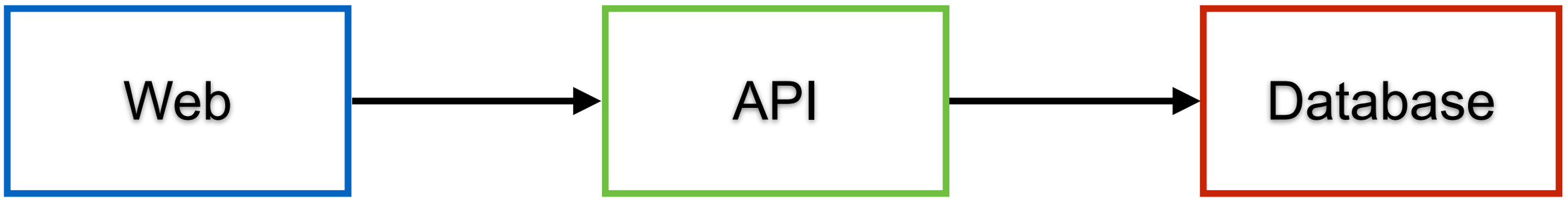
```
@ExtendWith(MockitoExtension.class)
public class DemoWithMockito {

    @Mock
    Random random;

    @Test
    public void usingMockito() {
        // Create stub
        when(random.nextInt(10))
                .thenReturn(5);
    }

}
```

Workshop with Login process

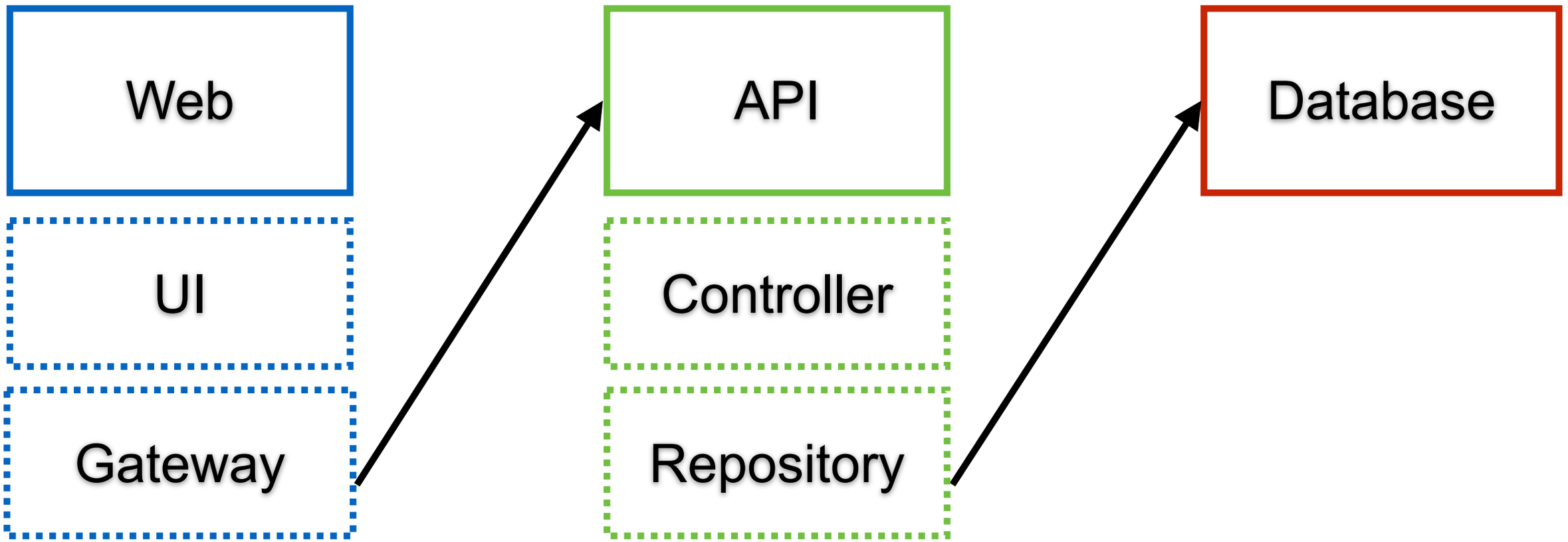
Test login

User name	Password	Expected result	Comment
Somkiat	PasswordSomKiat	Access to system as Somkiat	Valid
Som kiat	PasswordSomKiat	Error	Space in user
Somkiat	Password SomKiat	Error	Space in password
Somkiat	1234	Error	Password too short

Workshop :: Login

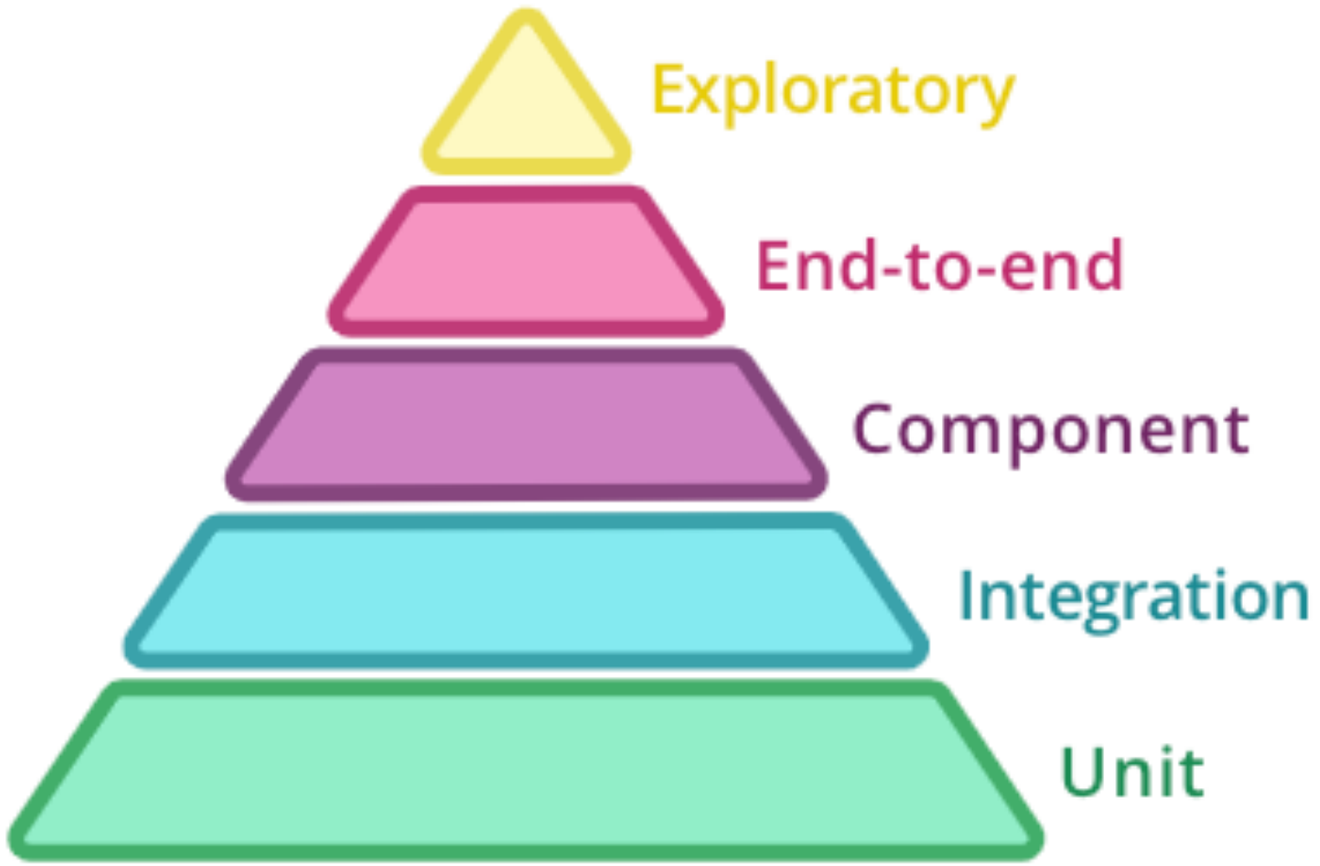


Workshop :: Login

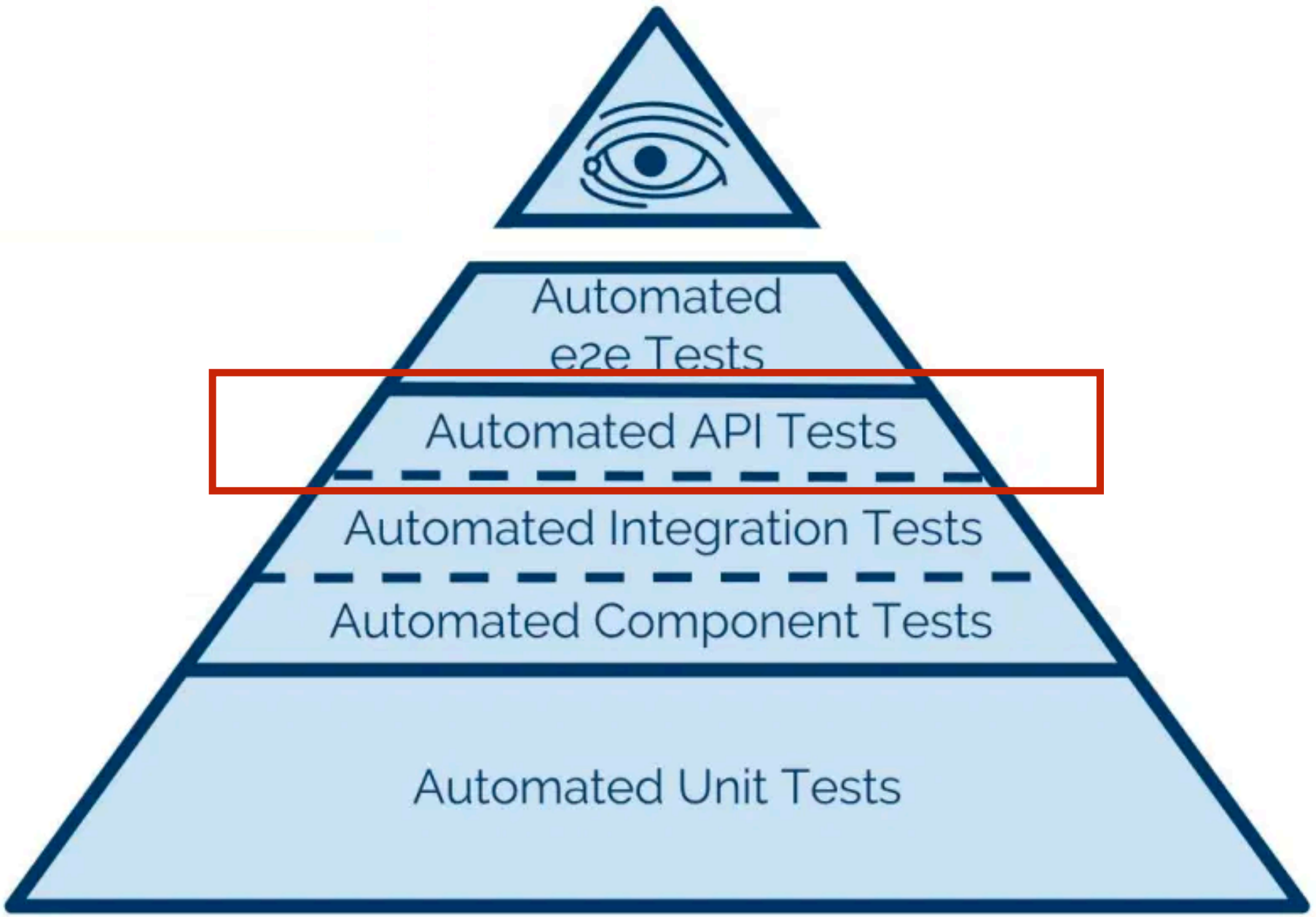


What to test ?

What to test ?



Somkiat	PasswordSomKiat	Access to system as Somkiat	Valid



Code Example

https://github.com/up1/demo-login-api

Books