# Back To Basics
## Testing

PHIL NASH


# What is a test?

# What is a test?

operation

# What is a test?

operation

+

input values

# What is a test?

operation

+

input values

expected output values

# What is a test?

operation

input values

expected output values

```
ASSERT_EQ( add(1, 2), 3 );
```

# What is a test?

operation

input values

expected output values

I run my program

I type in some input

I expect it to show specific output

# What is a test?

operation

input values

expected output values

Invoke the compiler

give it my code

It compiles successfully

# What is a test?

# What is a test?

Unit

Integration

System

# What is a test?

System Tests

Integration Tests

Unit Tests

# What is a test?

The testing pyramid

System Tests

Integration Tests

Unit Tests

# What is a Unit Test?

# What is a **Unit Test?**

Michael Feathers

"A test is **not** a unit test if:

- It talks to the **database**
- It communicates across the **network**
- It touches the **file system**
- It **can't run at the same time** as any of your other unit tests
- You have to do special things to your **environment** (such as editing config files) to run it "

*Michael Feathers - A Set of Unit Testing Rules*

# What is a **Unit Test?**

Michael Feathers

> "Tests that do these things aren't bad. Often they are worth writing, and they can be written in a unit test harness."

*Michael Feathers - A Set of Unit Testing Rules*

# What is a **Unit Test?**

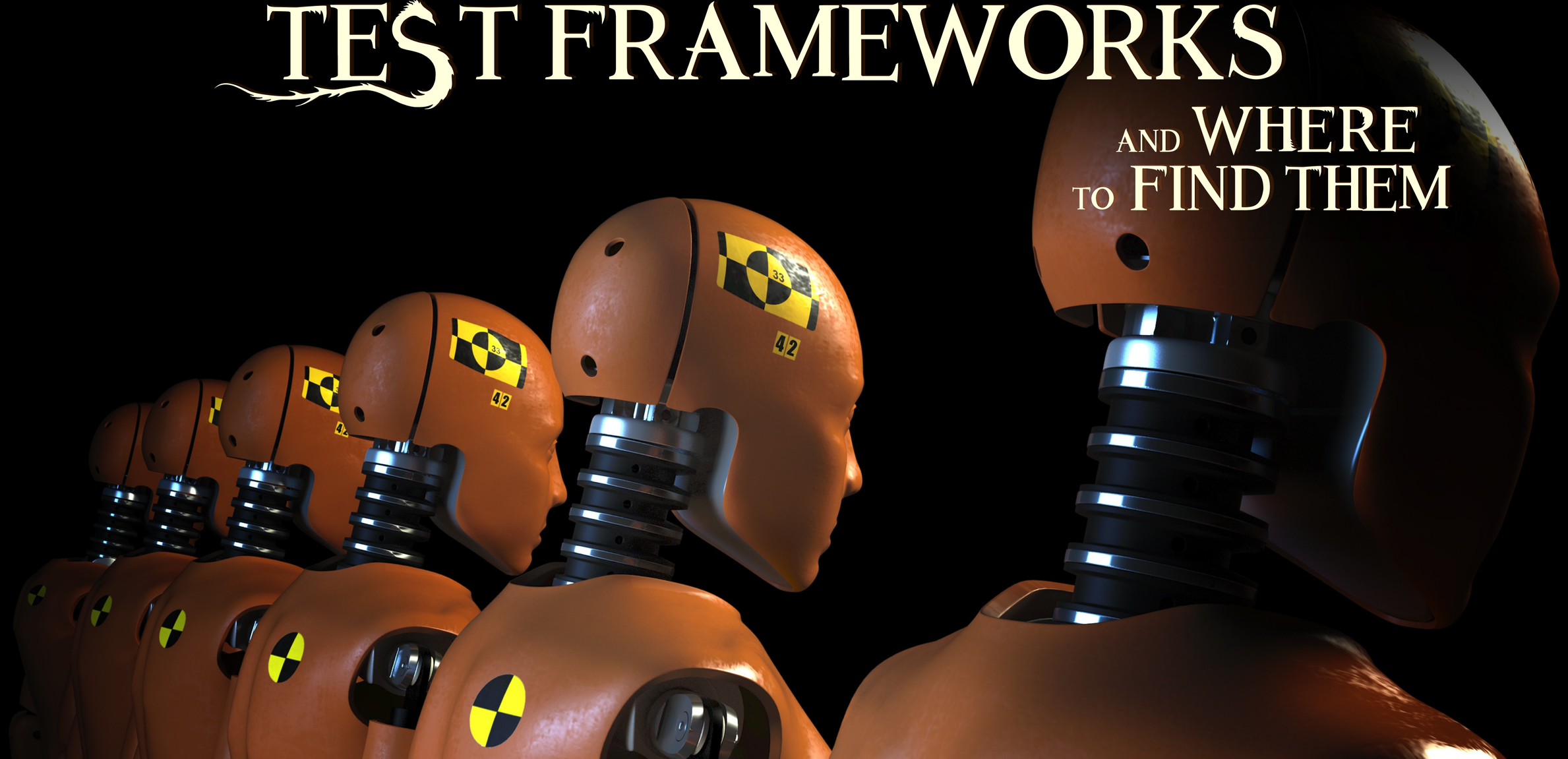
Michael Feathers

"Tests that do these things aren't bad. Often they are worth writing, and they can be written in a unit test harness.

However, it is important to be able to separate them from true unit tests so that we can keep a set of tests that we can **run fast whenever we make our changes**"

*Michael Feathers - A Set of Unit Testing Rules*

# FANTASTIC TEST FRAMEWORKS AND WHERE TO FIND THEM



# WHY USE A TEST FRAMEWORK

```
int add( int a, int b );
```

```c
#include <cassert>

int add( int a, int b );

int main() {
    assert( add( 1, 2 ) == 3 );
}
```

```c
#include <cassert>

int add( int a, int b );

int main() {
    assert( add( 1, 2 ) == 3 );
}
```

```
#include <cassert>


int add( int a, int b ){
    return a*b;
}


int main() {
   assert( add( 1, 2 ) == 3 );
}
```

```cpp
#include <cassert>

int add( int a, int b ){
    return a*b;
}

int main() {
   assert( add( 1, 2 ) == 3 );
}
```

```
Assertion failed: (add( 1, 2 ) == 3), function main,
  file /Users/phil/Dev/Scratch/AddTest/main.cpp, line 8.

Process finished with exit code 6
```

```cpp
#include <cassert>

int add( int a, int b ){
    return a*b;
}

int main() {
   assert( add( 1, 2 ) == 3 );
}
```

```
Assertion failed: (add( 1, 2 ) == 3), function main,
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int main() {
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int add( int a, int b ){
    return a*b;
}

int main() {
   assert( add( 1, 2 ) == 3 );
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```

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Assertion failed: (add( 1, 2 ) == 3), function main,
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Process finished with exit code 6
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## <cassert> pros:

- no dependencies
- some useful output (file, line, expr...)
- natural, familiar, syntax and usage

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- some useful output (file, line, expr...)
- natural, familiar, syntax and usage

## <cassert> cons:

- not enough feedback (breakdown of expr?)
- only console output
- no test names, groups/ suites
- aborts on first failure

en.wikipedia.org/wiki/List_of_unit_testing_frameworks

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# List of unit testing frameworks

From Wikipedia, the free encyclopedia

This article contains embedded lists that **may be poorly defined, unverified or indiscriminate**. Please help to clean it up to meet Wikipedia's quality standards. Where appropriate, incorporate items into the main body of the article. *(April 2018)*

This page is a list of tables of code-driven unit testing frameworks for various programming languages. Some but not all of these are based on xUnit.

**Contents** [hide]

# List of unit testing frameworks

2.11 C++

84 C++ Test frameworks!

# CppUnit

CppUnit

**CppUnitLite**

CppUnit

CppUnitLite

**Boost.Test**

CppUnit

CppUnitLite

Boost.Test

**Google Test**

CppUnit

CppUnitLite

Boost.Test

Google Test

**Catch/ Catch2**

CppUnit

CppUnitLite

Boost.Test

Google Test

Catch/ Catch2

**doctest**

CppUnit

CppUnitLite

Boost.Test

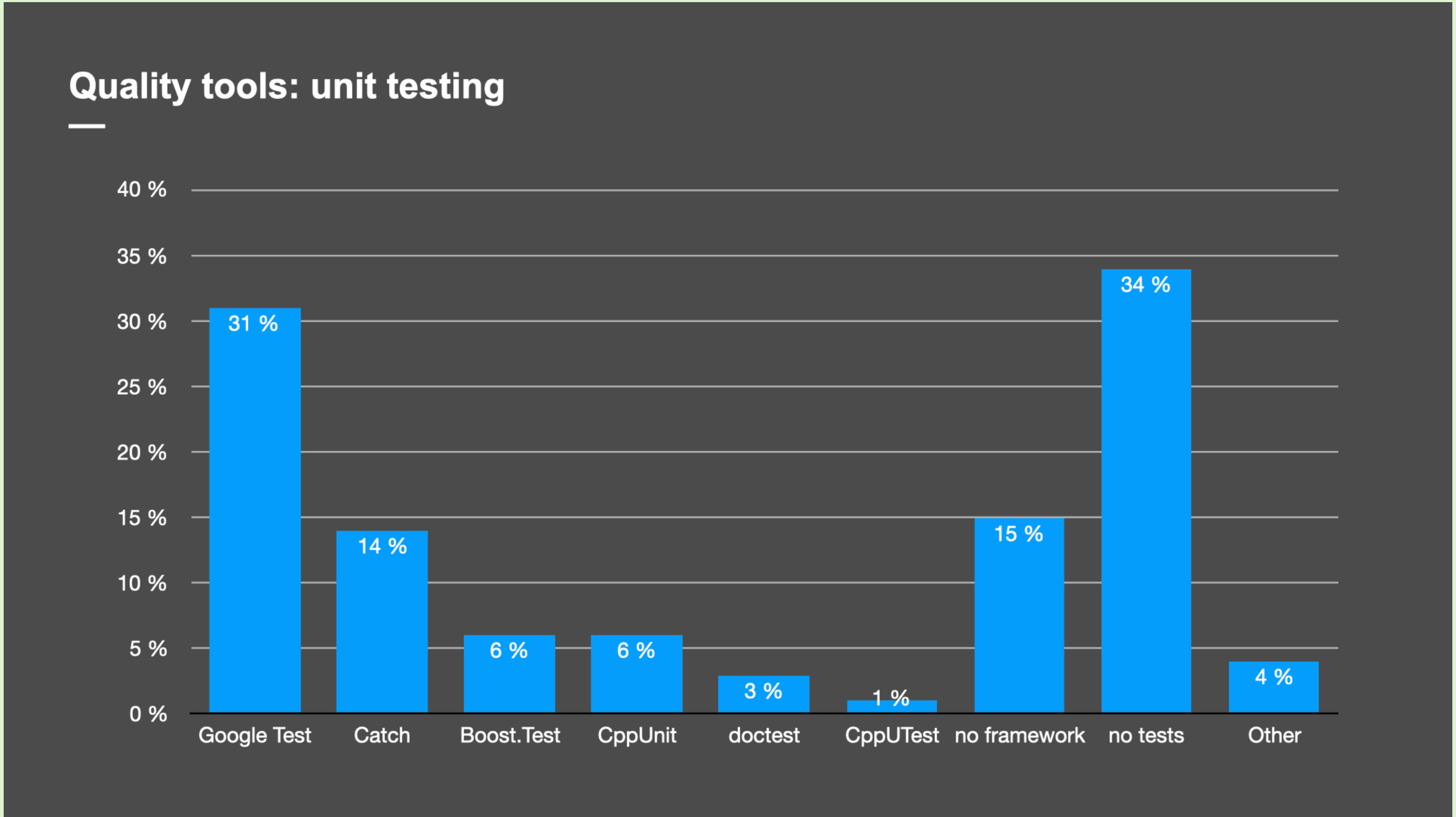
Google Test

Catch/ Catch2

doctest

**UT**

# JetBrains Developer Ecosystem report 2020



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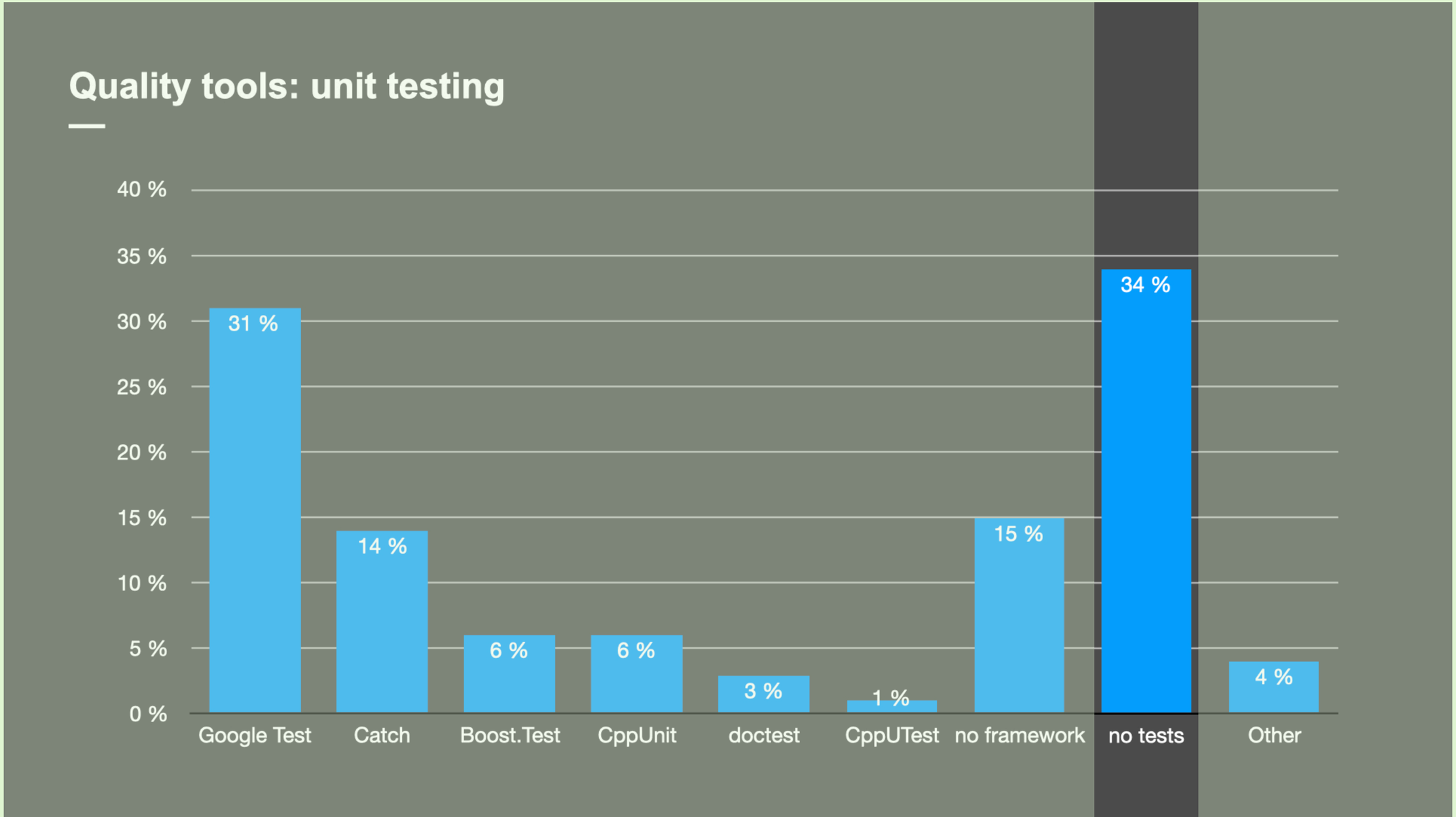
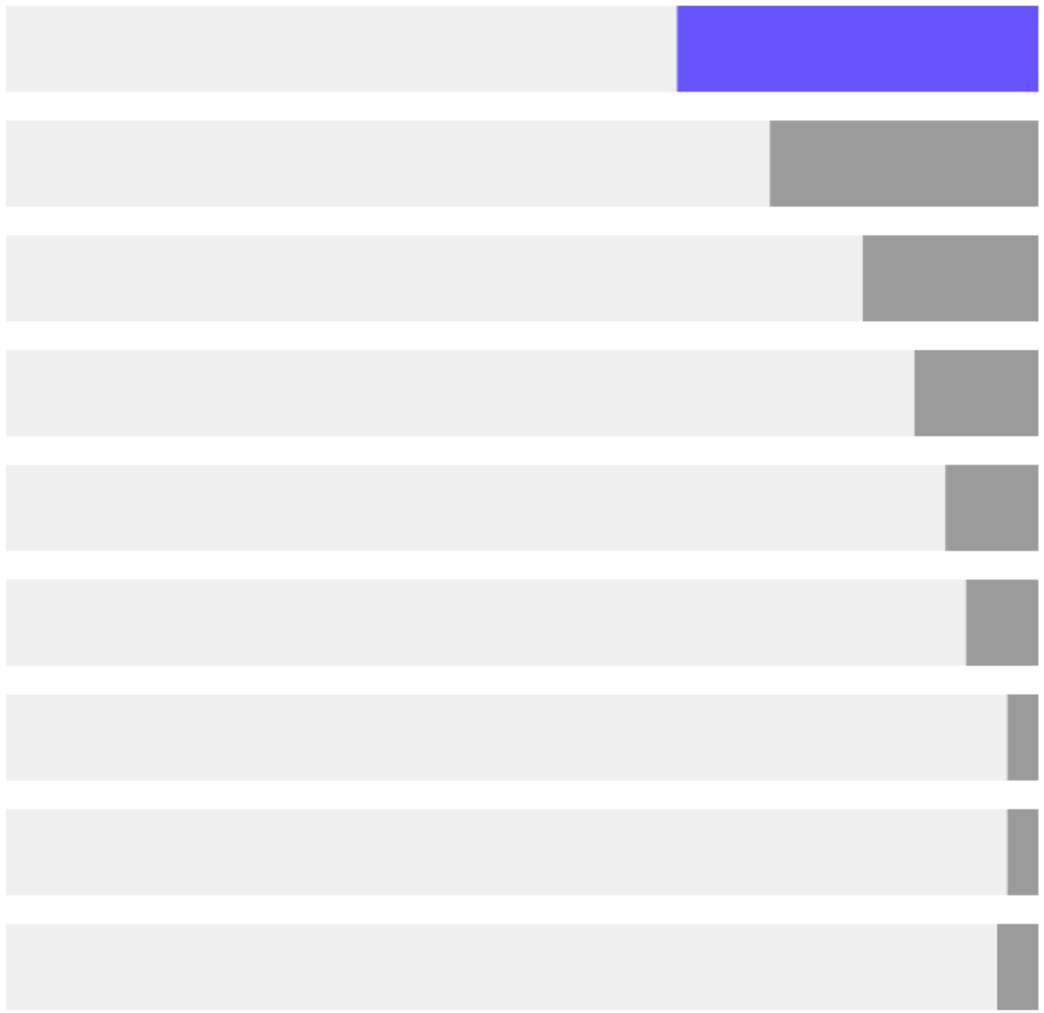


# JetBrains Developer Ecosystem report 2022



| | |
|---|---|
| **35%** | **Google Test** |
| 26% | I don’t write unit tests for C++ |
| 17% | I write unit tests but don’t use any frameworks |
| 12% | Catch |
| 9% | CppUnit |
| 7% | Boost.Test |
| 3% | CppUTest |
| 3% | doctest |
| 4% | Other |


Left-pad

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"

TEST_CASE("left pad") {
    /* .. */
}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"

TEST_CASE("left pad") {
    /* .. */
}
```

```
#include "gtest/gtest.h"

TEST(left_pad, empty) {
    /* .. */
}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"
TEST_CASE("left_pad pads strings to a minimum length") {

    /* .. */

}
```

```
#include "gtest/gtest.h"
TEST(left_pad_pads_strings_to_a_minimum_length, empty) {

    /* .. */

}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"
TEST_CASE("left_pad pads strings to a minimum length") {
    REQUIRE(left_pad("", 0) == "");
}
```

```
#include "gtest/gtest.h"
TEST(left_pad_pads_strings_to_a_minimum_length,
     an_empty_string_with_zero_padding) {
    ASSERT_EQ(left_pad("", 0), "");
}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"

TEST_CASE("left_pad pads strings to a minimum length") {

    REQUIRE(left_pad("", 0) == "");
    REQUIRE(left_pad("abc", 0) == "abc");

}
```

```
#include "gtest/gtest.h"

TEST(left_pad_pads_strings_to_a_minimum_length,
     not_padded_when_min_len_is_less_than_input_string_len) {

    ASSERT_EQ(left_pad("", 0), "");
    ASSERT_EQ(left_pad("abc", 0), "abc");

}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"

TEST_CASE("left_pad pads strings to a minimum length") {

    SECTION("When padding is < string length, the existing string is returned") {

        REQUIRE(left_pad("", 0) == "");
        REQUIRE(left_pad("abc", 0) == "abc");
    }
}
```

```
#include "gtest/gtest.h"

TEST(left_pad_pads_strings_to_a_minimum_length,
     not_padded_when_min_len_is_less_than_input_string_len) {

    ASSERT_EQ(left_pad("", 0), "");
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std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

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#include "gtest/gtest.h"

TEST(left_pad_pads_strings_to_a_minimum_length,
     not_padded_when_min_len_is_less_than_input_string_len) {
   ASSERT_EQ(left_pad("", 0), "");
   ASSERT_EQ(left_pad("abc", 0), "abc");
}

TEST(left_pad_pads_strings_to_a_minimum_length,
     padded_when_min_len_equal_than_input_string_len) {
  ASSERT_EQ(left_pad("abc", 3), "abc");
}

TEST(left_pad_pads_strings_to_a_minimum_length,
     padded_when_min_len_greater_than_input_string_len) {
  ASSERT_EQ(left_pad("abc", 4), " abc");
}
TEST(left_pad_pads_strings_to_a_minimum_length,
    custom_pad_char_can_be_used) {
  ASSERT_EQ(left_pad("abc", 5, '*'), "**abc");
}
```

```
std::string left_pad(std::string const& str, size_t min_len, char pad_char=' ');
```

```
#include "catch.hpp"

TEST_CASE("left_pad pads strings to a minimum length") {
    SECTION("When padding is < string length, the existing string is returned") {
        REQUIRE(left_pad("", 0) == "");
        REQUIRE(left_pad("abc", 0) == "abc");
    }

    SECTION("When padding is == string length, the existing string is returned") {
        REQUIRE(left_pad("abc", 3) == "abc");
    }

    SECTION("When padding is > string length, the returned string is padded") {
        REQUIRE(left_pad("abc", 4) == " abc");
    }

    SECTION("String can be padded with a custom char") {
        REQUIRE(left_pad("abc", 5, '*') == "**abc");
    }
}
```

# Testing

## Best Practices

# Testing

## Best Practices

### Unit Tests should:

- Run fast
- Be deterministic & reproducible
- Be self-contained/ isolated
- Be consistent & reliable
- Be obvious & self-documenting
- Be focused on one thing (“single assert”)
- Use public interfaces

# Testing

## Best Practices

**All tests should:**

- Be well named
- Provide clear and useful feedback
- Have a clear reason
- Have low cyclomatic complexity

```
TEST_CASE( "Most recently used list" ) {

    MRUList<std::string> list;

    SECTION( "An empty list has no elements" ) {
        REQUIRE( list.empty() );
        REQUIRE( list.size() == 0 );
    }
    SECTION( "Adding to an empty list increases the size to 1" ) {
        list.add("item1");
        REQUIRE( list.empty() == false );
        REQUIRE( list.size() == 1 );
    }
}
```

```
TEST_CASE( "An MRU list acts like a stack, "
           "but duplicate entries replace existing ones" ) {

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```

STATE EXPECTATIONS

# Unit Tests should be reproducible and deterministic

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```

"Arrange"

# Unit Tests should be reproducible and deterministic

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"Arrange"

"Act"

# Unit Tests should be reproducible and deterministic

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"Arrange"

"Act"

"ASSERT"

Tests should:

Have a single "Logical" Assert

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Single assert

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}
```

Dependency

Multiple asserts

# The Challenges & Pitfalls of Testing

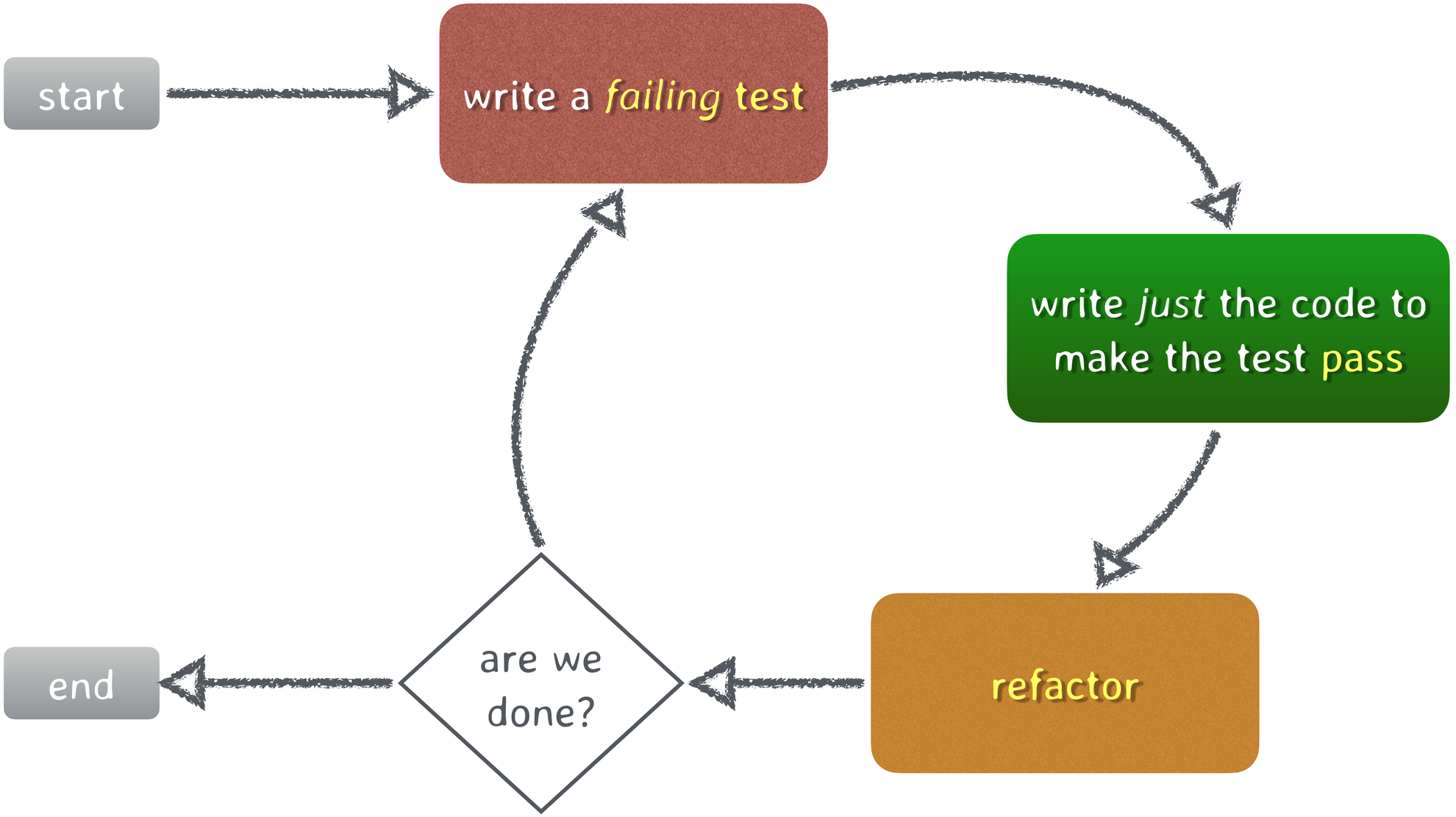
# The Challenges & Pitfalls of Testing

- Flakey tests
- Slow tests
- Brittle tests
- Hard to write

# What next?

# What next?

- Get comfortable with the best practices
- Become familiar with the design principles
- Pay attention to when testing is harder
- **Then** consider trying TDD


start
write a failing test
write just the code to make the test pass
refactor
are we done?
end


Design

# The SOLID principles

**SRP** Single Responsibility Principle

**OCP** Open-Closed Principle

**LSP** Liskov Substitution Principle

**ISP** Interface Segregation Principle

**DIP** Dependency Inversion Principle

Cppcon

The C++ Conference

# Breaking Dependencies: The SOLID Principles

Klaus Iglberger

2020

September 13-18

# Seeking Simplicity

**NDC** { London }

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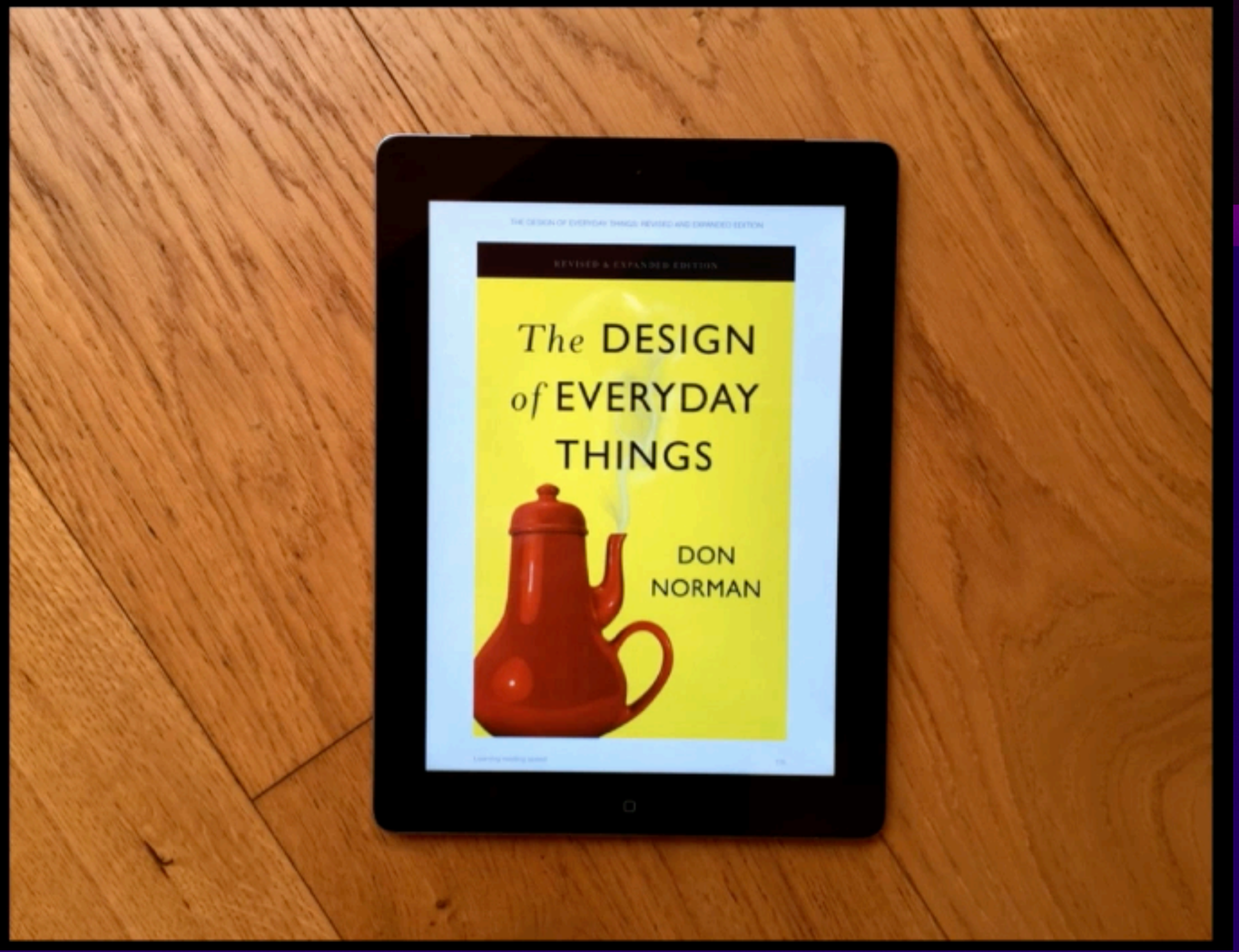

# *Back To Basics*
# Testing

**levelofindirection.com**/refs/testing.html

**PHIL NASH**


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