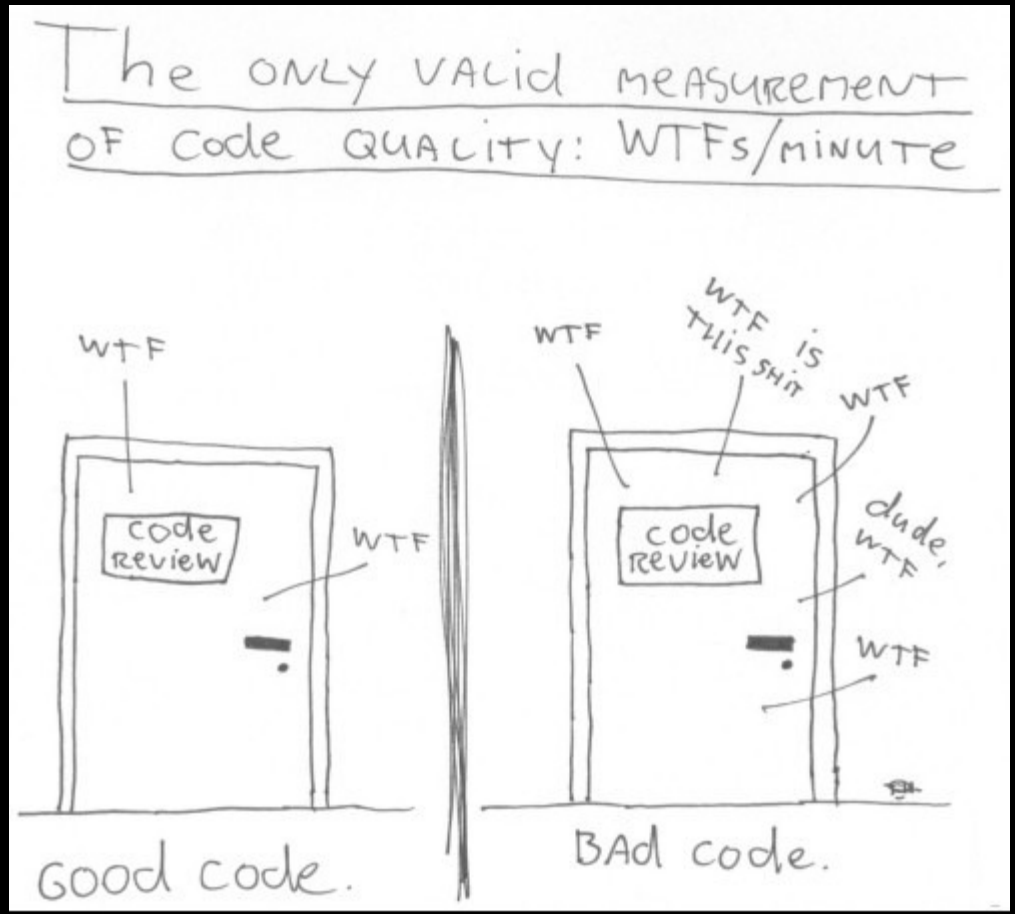
Unit Testing



Part One

Introduction

Exercise

What is a Unit Test ?

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“A **Test method** which verifies the correct behaviour of a single **Unit of Work**.”

- Fast-running
- Trustworthy

Exercise

Why Unit Test ?

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Reason One: To test your code…

- New code (developer acceptance test)
- Updated code (regression test)

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TDD’ers will tell you this is not the reason they write Unit Tests

Why Unit Test ?

Reason Two: To verify / flesh-out requirements

= Tests as Specification

Why Unit Test ?

Reason Three: To better understand a system

= Tests as Documentation

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Reason Three: To better understand a system

= Tests as Documentation

Unit Tests tells you **what** the system should do.
Code tells you **how** it is done.

Why Unit Test ?

Reason Four: To reduce risk

- Refactoring

Why Unit Test ?

Reason Five: To write better architected code

- **Focus** efforts on only writing enough code to make a failing test case pass
- Approach development from the **Client perspective** (rather than the Server)

Why Unit Test ?

Reason Six: To save time

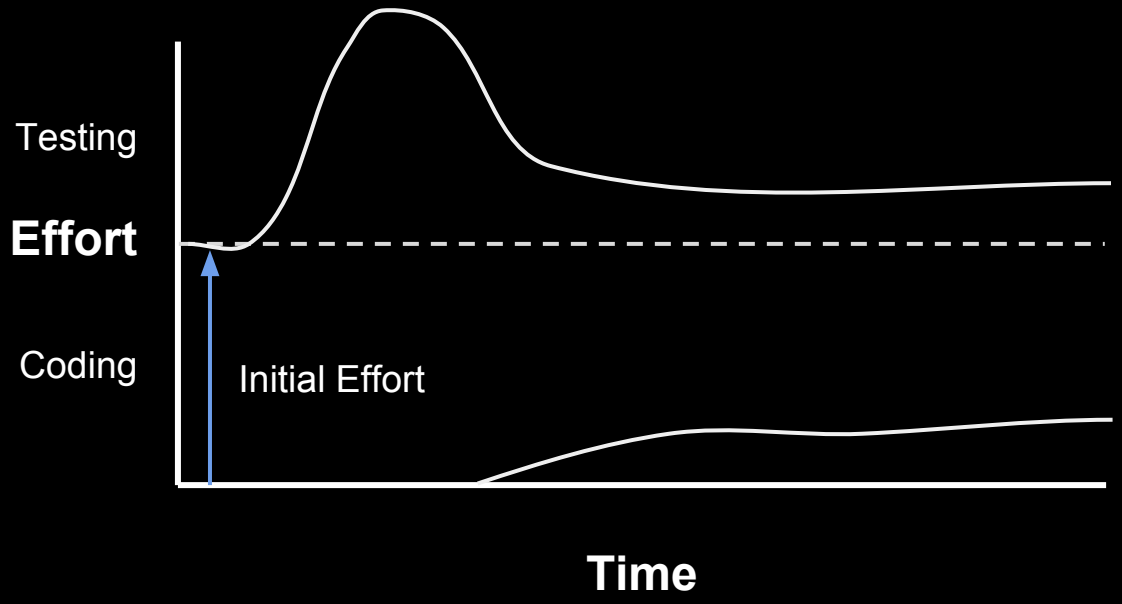
Modest up-front investment

Pays dividends later on

Diagram

Cost Benefit over Time

Cost Benefit over Time



How to do Unit Testing

7 Habits of Highly Effective Tests

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1. Simple

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2. Fast-running

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3. Single execution path

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7. Write your test first (TDD)

Habits of Highly Effective Tests

1. Simple
2. Fast-running
3. Single execution path
4. Verify a single condition
5. Developed as 1st-class citizens
6. Intent-revealing coding
7. Write your test first (TDD)
8. Isolate your SUT

Terms

SUT = System Under Test

DOC = Depended-On Component

TCC = Test Case Class

Fixture = execution context for a test (created by TCC)

4 Phase Test

xUnit	TDD	BDD
Setup	Arrange	Given
Execute	Act	When
Verify	Assert	Then
Tear-down		

Demo

xUnit Refactoring Walkthrough

Part Two

Naming Conventions

Exercise

Unit Test Naming

Feature: Flight Management

Scenario: Cancelling a Flight

Given a Flight
When I cancel the Flight
Then the Flight Status should be Cancelled

Feature: Online Payments

Scenario: making a Payment from an Account with Insufficient Funds.

Given an Account with no Available Balance
When I try to make a Payment
Then the Payment should be Rejected

Feature: User trades stocks

Scenario: User requests a Sell before Close of Trading

Given I have 100 shares of MSFT stock
And I have 150 shares of APPL stock
And the time is before close of trading
When I ask to sell 20 shares of MSFT stock
Then I should have 80 shares of MSFT stock
And I should have 150 shares of APPL stock
And a sell order for 20 shares of MSFT stock should have been executed

Unit Test Naming Goals

- Unambiguous
- Concise
- Use of Ubiquitous Language
- Consistent

Unambiguous Name

Components of a Unit Test name:

- Method
- Scenario:
  - Initial state of SUT
  - Key Inputs
- Expected Outcome

Test Naming Strategies

- ‘Freestyle’
- Structured

Freestyle Test Naming

- TestNameInPascalNotation

- Or_use_snake_notation_for_readability

Freestyle

Divide_by_zero_should_throw_exception

If_no_accounts_selected_should_retrieve_transactions_for_first_transactional_account

Adding_3_integers_should_return_sum

Freestyle

Divide_by_zero_should_throw_exception

If_no_accounts_selected_should_retrieve_transactions_for_first_transactional_account

Adding_3_integers_should_return_sum

Freestyle

Should_throw_exception_when_divide_by_zero

Should_retrieve_transactions_for_first_transactional_account_if_no_accounts_selected

Should_return_sum_when_when_adding_3_integers

Structured Naming

- Method_Scenario_Outcome
- UnitOfWork_Scenaio_Outcome

Structured Naming

Divide_ByZero_ThrowsException

OnLoad_NoAccountsSelected_GetsTransactionsForFirstTransactionalAccount

Add_3Integers_ReturnsSum

Test Organisation & Naming

Organisation pattern:

Testcase Class Per Method

Alternative

- BDD Naming

User Story

Title: [some activity]

Narrative:

As a [role]

I want [feature]

So that [benefit]

Acceptance Criteria:

Scenario 1: [title]

Given [context]

When [event]

Then [outcome]

Scenario 2: [title]

Given [context]

When [event]

Then [outcome]

NSpec (1st Generation BDD)

```
void Given_10()
{
        before = () => calc = new Calculator();

        it["should return 11 when adding 1"]
        = () => calc.Add(10, 1).should_be(11);

        it["should throw divide by zero exception when dividing by 0"]
        = expect<DivideByZeroException>(() => calc.Divide(10, 0));
}
```

Demo

NSpec (1st Generation BDD)

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SpecFlow (2nd Generation BDD)

Acceptance Criteria:

Scenario: Cancelling a Flight

Given I have a Flight

When I Cancel the Flight

Then the Flight status should change to Cancelled

Demo

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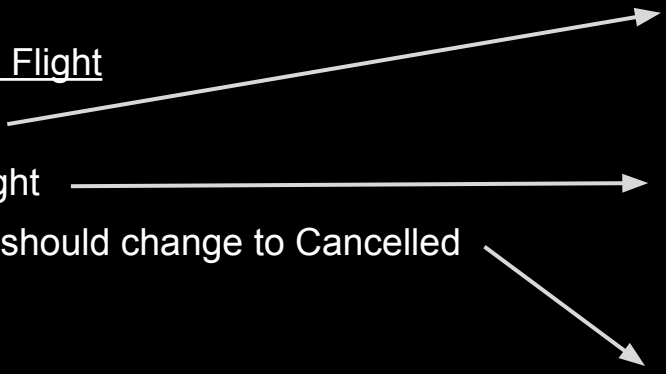

```
[Given(@"I have a Flight")]
public void GivenIHaveAFlight()
{
    ...
}

[When(@"I Cancel the Flight")]
public void WhenICancelTheFlight()
{
    ...
}

[Then(@"the Flight status should change to Cancelled")]
public void ThenTheFlightStatusShouldChangeToCancelled()
{
    ...
}
```

Part Three

Patterns

xUnit Patterns

4 Phase Test:

- Setup (Arrange)
- Execution (Act)
- Verification (Assert)
- Tear-down

Fixture Patterns

Life-cycle:

1. Fresh Fixture
    - New fixture for every test method

2. Shared Fixture
    - All test methods share common fixture

Demo

Setup (Arrange)

3 main setup patterns:

- Inline setup
- Delegated setup
- Implicit setup

Verification (Assert)

Two main verification strategies:

- State verification
- Behaviour verification

Diagram

State Verification

- Simpler (normal) approach
- Verify direct outputs of the SUT

Demo

State Verification

- Two variations:
  - Procedural state verification
  - Expected state specification

Behaviour Verification

- More complicated
- Dynamic - need to catch the SUT ‘in the act’
- Verify indirect outputs to DOCs
- Requires the use of specialised Test Doubles
- Set expectations on DOC methods

Test Doubles

- The stunt doubles of the unit testing world
- Flavours:
  - Stubs
  - Mocks
  - Spies
  - Fakes
  - Dummies

Isolation Frameworks

Isolate the SUT from DOCs

- Stubs
- Mocks
- Spies

Stubs

- Return ‘canned’ data
- Supply inputs into the SUT from DOC
- Can have multiple stubs in a unit test

Mocks

- Test **outputs** from the SUT
- Do not return data
- Verify that invocation expectations have been met
- There should only be a **single Mock per test**

Spies

- Specialised Stubs
- Return data *and* audit calls
- Only a single Spy or Mock per test

Creation Methods

- Extract common / complicated / irrelevant Setup logic into dedicated method

Creation Methods

- Allow intent-revealing coding
- Two variations:
  - Anonymous Creation Method
  - Parameterised Creation Method

- Test Code Duplication
- Obscure Test
  - Irrelevant Information

Custom Assertions

- Extract common / multi-step assertion logic into dedicated method

Custom Assertions

- Allow intent-revealing coding

- Test Code Duplication
- Obscure Test
  - Irrelevant Information

Part Four

Smells

Obscure Test

- A test which is difficult to understand
- Two main causes:
  - Too little information
  - Too much information

Too Little Information

- Mystery Guest
  - part of the Setup / Verification logic done outside the test.

Mystery Guest

```
public void testGetFlightsByFromAirport_OneOutboundFlight_mg()
{
        loadAirportsAndFlightsFromFile("test-flights.csv");

        // Exercise System
        List flightsAtOrigin = facade.getFlightsByOriginAirportCode( "YYC");

        // Verify Outcome
        assertEquals( 1, flightsAtOrigin.size());
        FlightDto firstFlight = (FlightDto) flightsAtOrigin.get(0);
        assertEquals( "Calgary", firstFlight.getOriginCity());
}
```

Too Much Information

- Eager Test
  - Trying to verify too many conditions in a single test
  - Can lead to Assertion Roulette
- Irrelevant Information
  - Inclusion of logic which doesn’t materially affect the test

Eager Test

```
public void testFlightMileage_asKm2() {
        // set up fixture
        // exercise constructor
        Flight newFlight = new Flight(validFlightNumber);
        // verify constructed object
        assertEquals(validFlightNumber, newFlight.number);
        assertEquals("", newFlight.airlineCode);
        assertNull(newFlight.airline);
        // set up mileage
        newFlight.setMileage(1122);
        // exercise mileage translator
        int actualKilometres = newFlight.getMileageAsKm();
        // verify results
        int expectedKilometres = 1810;
        assertEquals( expectedKilometres, actualKilometres);
        // now try it with a canceled flight
        newFlight.cancel();
        try {
                newFlight.getMileageAsKm();
                fail("Expected exception");
        } catch (InvalidRequestException e) {
                assertEquals( "Cannot get cancelled flight mileage",
                e.getMessage());
        }
}
```

Conditional Test Logic

- Test contains code that may or may not be executed

```
if(flightsFromCalgary != null) {
        i = flightsFromCalgary.iterator();
        while (i.hasNext()) {
                FlightDto flightDto = (FlightDto) i.next();
                if (flightDto.getFlightNumber().equals(
                expectedCalgaryToVan.getFlightNumber()))
                {
                        assertEquals("Flight from Calgary to Vancouver",
                                expectedCalgaryToVan,
                                flightDto);
                        break;
                }
        }
}
```

```
flightsFromCalgary.Should().Not.BeNull();   // guard assertion

i = flightsFromCalgary.iterator();
while (i.hasNext()) {
        FlightDto flightDto = (FlightDto) i.next();
        if (flightDto.getFlightNumber().equals(
        expectedCalgaryToVan.getFlightNumber()))
        {
                assertEquals("Flight from Calgary to Vancouver",
                        expectedCalgaryToVan,
                        flightDto);
                break;
        }
}
```

```
flightsFromCalgary.Should().Not.BeNull();   // guard assertion

flightDto = FindFlight(flightsFromCalgary, expectedCalgaryToVan);  // test utility method

assertEquals("Flight from Calgary to Vancouver",
        expectedCalgaryToVan,
        flightDto);
```

Test Code Duplication

- The same test code is repeated many times

Part Five

Tooling

Unit Testing Frameworks

- Framework
  - Attributes
  - Assertion methods

- Test Runner
  - Executing tests
  - Displaying results

Test Runners

- Visual Studio
  - Test Runner
    - Built-in support for MSTest
    - Plugins for other frameworks
  - 3rd Party - Resharper, TestDriven.NET
  - Command-Line
- Custom
  - NUnit test runner
  - XUnit GUI

MSTest

- Integrated into Visual Studio
- Basic
- Not extensible
- No parameterised Tests

NUnit

- Proven - but dated
- Uses stand-alone test runner
- Can use plugin to integrate with VS

XUnit

- NUnit modernised
- Good extensibility
- Opinionated
- Assert.Throws()

Part Six

TDD Kata

String Calculator

int Add(string numbers)

Requirements

1. An empty string returns 0

Requirements

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2. A single number return the value

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8. A single char delimiter can be defined on the first line (e.g. //# for a ‘#’ as the delimiter)
9. A multi char delimiter can be defined on the first line (e.g. //[###] for ‘###’ as the delimiter)