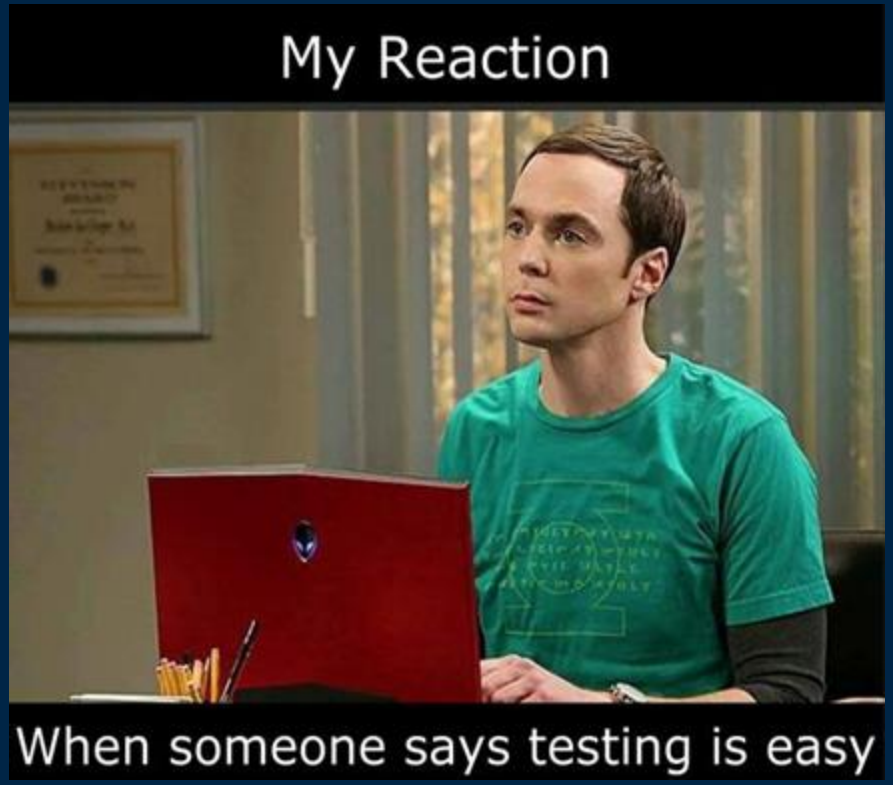
Introduction to Unit Tests



HENRIK BITSCH KIRK
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Agenda

Motivation
Case study: NUnit
Testing
    Basic parts of a unit tests
    What does a unit test look like?

Manually test

```
public class Calculator {
   public double Add(double a, double b) {
      return a + b;
   }

   public double Subtract(double a, double b) {
      return a - b;
   }

   public double Multiply(double a, double b) {
      return a * b;
   }

   public double Power(double a, double b) {
      return Math.Pow(a,b);
   }
}
```

```
class Program
{
    static void Main(string[] args)
    {
        // Declare the unit-under-test
        var uut = new Calculator();

        // Test Add()
        Console.WriteLine("Add({0}, {1}) = {2}", 3.5, 2.5, uut.Add(3.5, 2.5));
        Console.WriteLine("Add({0}, {1}) = {2}", -3.5, 2.5, uut.Add(-3.5, 2.5));
        Console.WriteLine("Add({0}, {1}) = {2}", -3.5, -2.5, uut.Add(-3.5, -2.5));

        // Test Subtract()
        Console.WriteLine("Subtract({0}, {1}) = {2}", 3.5, 2.5, uut.Subtract(3.5, 2.5));
        Console.WriteLine("Subtract({0}, {1}) = {2}", -3.5, 2.5, uut.Subtract(-3.5, 2.5));
        Console.WriteLine("Subtract({0}, {1}) = {2}", -3.5, -2.5, uut.Subtract(-3.5, -2.5));

        // Test Multiply()
        Console.WriteLine("Multiply({0}, {1}) = {2}", 3.5, 2.5, uut.Multiply(3.5, 2.5));
        Console.WriteLine("Multiply({0}, {1}) = {2}", -3.5, 2.5, uut.Multiply(-3.5, 2.5));
        Console.WriteLine("Multiply({0}, {1}) = {2}", -3.5, -2.5, uut.Multiply(-3.5, -2.5));

        // Test Power()
        Console.WriteLine("Power({0}, {1}) = {2}", 2.0, 3.0, uut.Power(2.0, 3.0));
        Console.WriteLine("Power({0}, {1}) = {2}", -2.0, 3.0, uut.Power(-2.0, 3.0));
        Console.WriteLine("Power({0}, {1}) = {2}", -2.0, -3.0, uut.Power(-2.0, -3.0));
    }
}
```

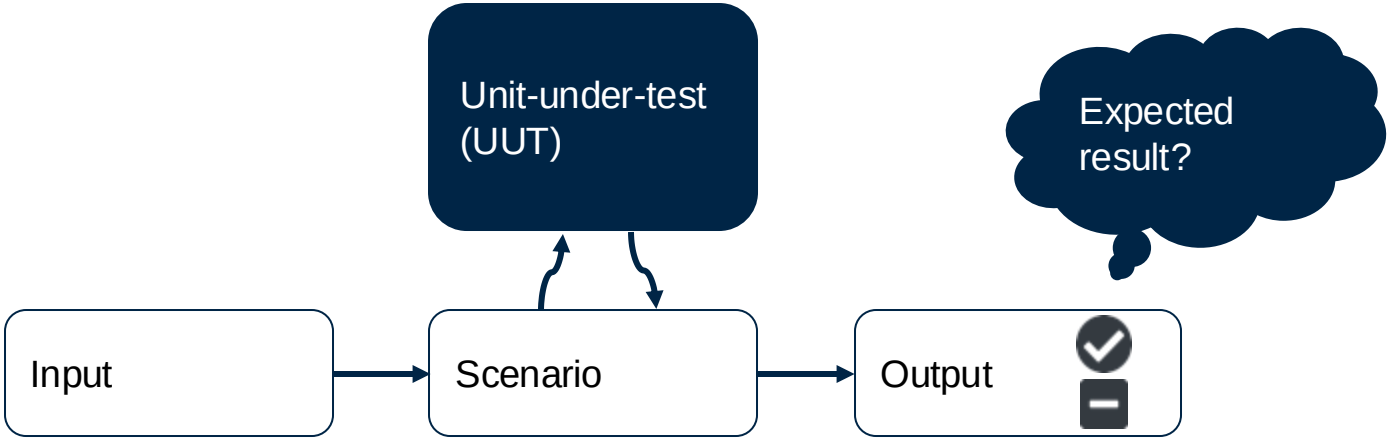
Validate result?

C:\WINDOWS\system32\cmd.exe

```
Add(3,5, 2,5) = 6
Add(-3,5, 2,5) = -1
Add(-3,5, -2,5) = -6
Subtract(3,5, 2,5) = 1
Subtract(-3,5, 2,5) = -6
Subtract(-3,5, -2,5) = -1
Multiply(3,5, 2,5) = 8,75
Multiply(-3,5, 2,5) = -8,75
Multiply(-3,5, -2,5) = 8,75
Power(2, 3) = 8
Power(-2, 3) = -8
Power(-2, -3) = -0,125
Press any key to continue . . .
```


Las journal:

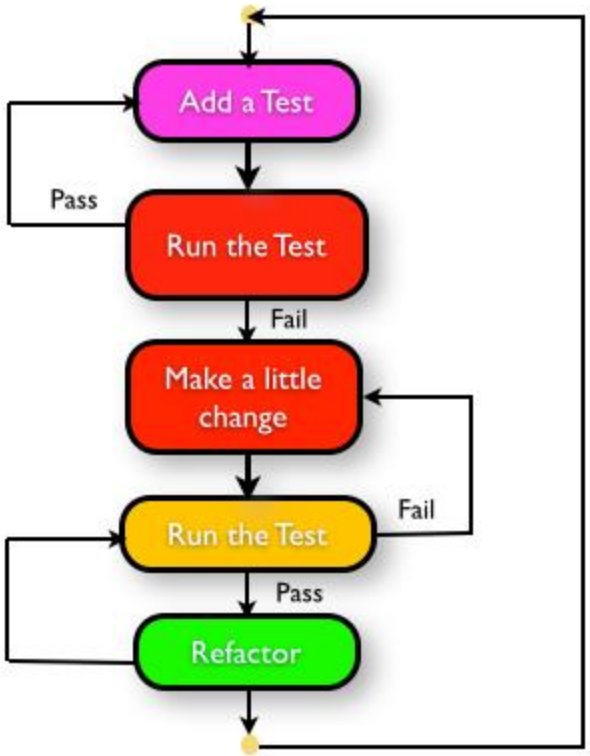
A unit tests



Icons: FrICONiX.com

How to plan and execute test

1. Define a scenario
2. Write the `[TestCase]`
3. Run the test
4. Implement the code
5. Repeat



Demo: A cash register

We will implement and test a class CashRegister (UUT)

CashRegister
+ AddItem(price: double) + GetNItems(): int + GetTotal(): double

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Your turn: What test cases do we need for each of the class' methods?

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Your turn: What test cases do we need for each of the class' methods?

What is the scenario?
What is the test input?
What is the expected result?

Test also gives...

specifications built into the program

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confidence in code

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early error finding

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decoupled system

Test also gives...

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better design

Your turn

For around 30 minutes do

1. Do ‘**Exercise 1: Plan your tests**’
2. Continue to **‘Exercise 2: Prepare workspace**’ after complete **Exercise 1**.


nunit

Test framework

Gives:

- Support for automation
- Easy setup and removal
- Good assertion constructs
- Detailed test reports
- Nice IDE integration
- Testing styles

Automation / test report

MultiTest (26)

TestMethodMSOutput1	19 ms
TestMethodMs4	
TestMethodMs5	
AsyncTestMS1	1 ms
BaseTestMethod1	< 1 ms
DerivedTestMethod	< 1 ms
NameTest	3 ms
TestAddInNet4	2 ms
TestMethodMs1	2 sec
TestMethodMs11	201 ms
TestMethodMs12	< 1 ms
TestMethodMs2	2 sec
TestMethodMs3	3 sec
TestMethodMs6	< 1 ms
TestMethodMSOutput2	< 1 ms
TestMethodN1	
TestMethodN11	
TestMethodN12	
TestMethodN2	
TestMethodN3	
TestMethodX1	

```
{
    [TestClass]
    1 reference
    abstract public class MSUnitTestBase
    {
        [TestMethod]
        0 references
        public void BaseTestMethod1()
        {
            Assert.IsTrue(true);
        }
    }
```

100 %

Output

Show output from: Tests

```
------ Run test started ------
========== Run test finished: 18 run (0:00:07,9559915) ==========
```

Nunit example

```
[TestFixture]
public class UnitTest1 {
    Calculator uut;
    [Setup]
    public void Setup() {
            uut = new Calculator();
    }

    [Test]
    public void Test_AddMethod() {
            double res = uut.Add(3.5, 2.5);
            Assert.AreEqual(res, 6);
    }
    …
}
```

NUnit assertion - constraints

Constraint-based assert model

```
Assert.That(uut.Count, Is.EqualTo(10));
```

Actual state

Constraint with expected state

More constraints https://nunit.org/docs/2.5/constraintModel.html

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Constraint-based assert model

```
Assert.That(uut.Count, Is.EqualTo(10));
```

Actual state

Constraint with expected state

Other constraints examples - many more exists

```
Assert.That(uut.Count, Is.GreaterThan(3));
Assert.That(myString, Is.EqualTo("Hello"));
Assert.That(array, Has.Exactly(3).LessThan(100));
```

More constraints https://nunit.org/docs/2.5/constraintModel.html

Test framework

Assertions Different ways to compare expected and actual test results in a readable way

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Test runner Runs the tests and reports the result

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Test fixture Collects test cases and helps with setup, teardown, etc.

Test runner Runs the tests and reports the result

Test reports Results of the tests run

Demo: A cash register

Let us implement the CashRegister and TestFixture

CashRegister
+ AddItem(price: double) + GetNItems(): int + GetTotal(): double

Your turn

Continue with exercises

Note: We summarize at the end of the lecture

Testing

and Pitfalls

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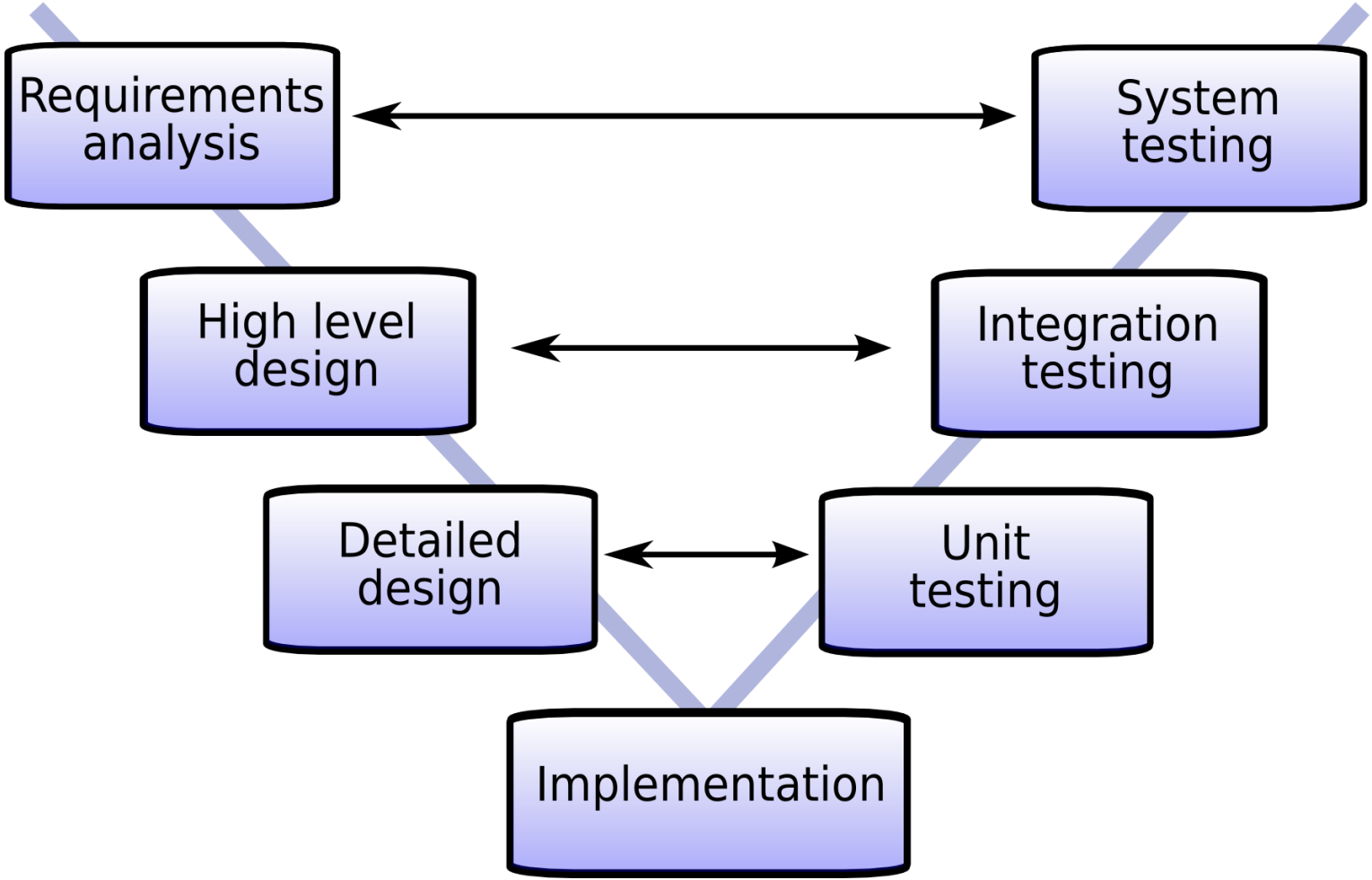
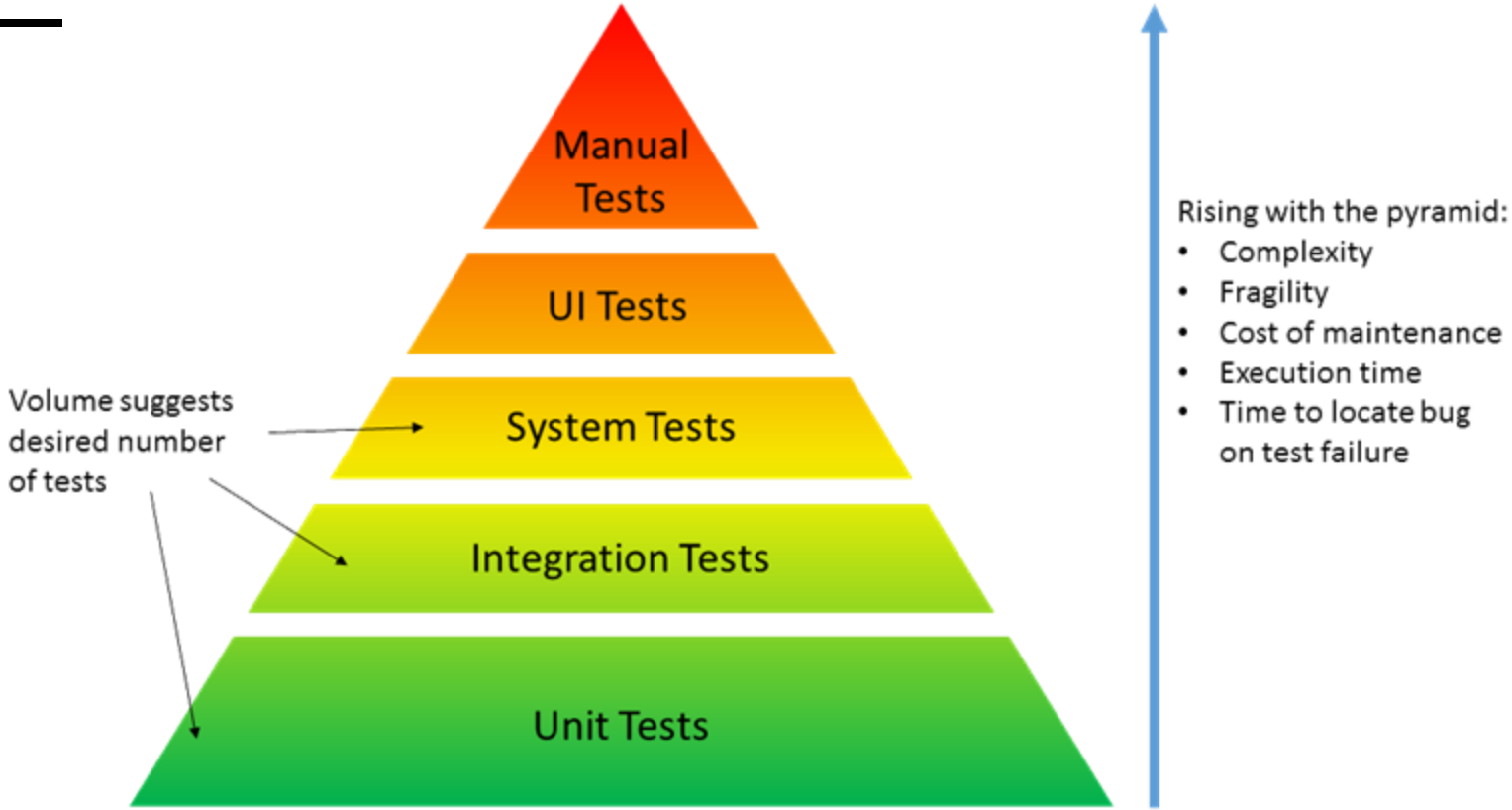

Requirements analysis
System testing
High level design
Integration testing
Detailed design
Unit testing
Implementation

Why test? Why unit test?



Pitfalls

The true unit test contains information about the design and behavior of UUT (Unit-under-test)

Do not make any assumptions about other parts

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Integration-test **do not** tell anything about how the code base is broken down into units

- Make assumptions about the whole system's behavior

Pitfalls

The true unit test contains information about the design and behavior of UUT (Unit-under-test)

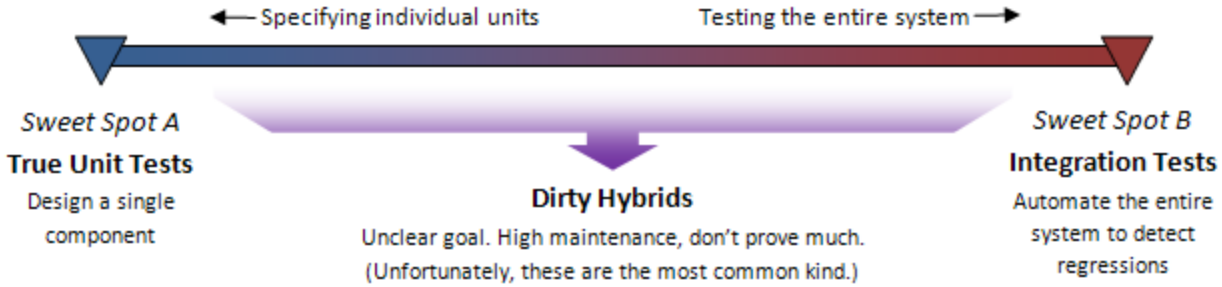
- **Do not** make any assumptions about other parts

Integration-test **do not** tell anything about how the code base is broken down into units

- Make assumptions about the whole system's behavior

In between

- Small changes break unrelated test
- Tests break - but the system works as “expected”



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Reference

TDD: agilefaqs.com/services/training/test-driven-development

Dancing man: https://giphy.com