



Unit Testing

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Goal

- How can I trust that the changes did not destroy something?
- What is my confidence in the system?
- How do I write tests?
- What is unit testing?
- What is SUnit?



Tests

- Tests represent your *trust* in the system
- Build them *incrementally*
 - Do not need to focus on *everything*
 - When a *new* bug shows up, write a test
- Even better write them before the code
 - Act as your *first client*, better interface
- Active documentation always in sync



Testing Style

“The style here is to write a few lines of code, then a test that should run, or even better, to write a test that won't run, then write the code that will make it run.”

- write unit tests that thoroughly test a single class
- write tests as you develop (even before you implement)
- write tests for every new piece of functionality

“Developers should spend 25-50% of their time developing tests.”



But I can't cover everything!

- Sure! Nobody can but
- When someone discovers a defect in your code, first write a test that demonstrates the defect.
 - Then debug until the test succeeds.

“Whenever you are tempted to type something into a print statement or a debugger expression, write it as a test instead.” Martin Fowler



Unit Testing

- Ensure that you get the specified behavior of the public interface of a class
- Normally tests a single class
- A **test**
 - Create a **context**,
 - Send a **stimulus**,
 - Check the **results**



SetTestCase

Class: SetTestCase
superclass: TestCase

SetTestCase>>testAdd

| empty |

empty := Set new.

empty add: 5.

self **assert:** (empty includes: 5).

“Context”

“Stimulus”

“Check”

SetTestCase run: #testAdd



In a subclass of TestCase

Each method starting with test*

Represents a test

Is automatically executed

The results of the test are collected in a TestResult object



Examples

testExampleRunArray3

"this demonstrates that adjacent runs with equal attributes are merged."

```
| runArray |
```

```
runArray := RunArray new.
```

```
runArray
```

```
  addLast:TextEmphasis normal times: 5;
```

```
  addLast:TextEmphasis bold times: 5;
```

```
  addLast:TextEmphasis bold times: 5.
```

```
self assert: (runArray runs size = 2).
```



Failures and Errors

- A *failure* is a failed assertion, *i.e.*, an anticipated problem that you test.
- An *error* is a condition you didn't check for.

```
SetTestCase>>removeElementNotInSet
```

```
self should: [Set new remove: 1]  
raise: Error
```



Good Tests

- Repeatable
- No human intervention
- “self-described”
- Change less often than the system
- Tells a story



Unit Frameworks

- `unittest` is a simple “testing framework” that provides:
 - classes for writing *Test Cases* and *Test Suites*
 - methods for *setting up* and *cleaning up* test data (“fixtures”)
 - methods for making *assertions*
 - textual and graphical tools for running tests
- `unittest` distinguishes between failures and errors:
 - A failure is a failed assertion, *i.e.*, an anticipated problem that you test.
 - An error is a condition you didn’t check for.



JUnit

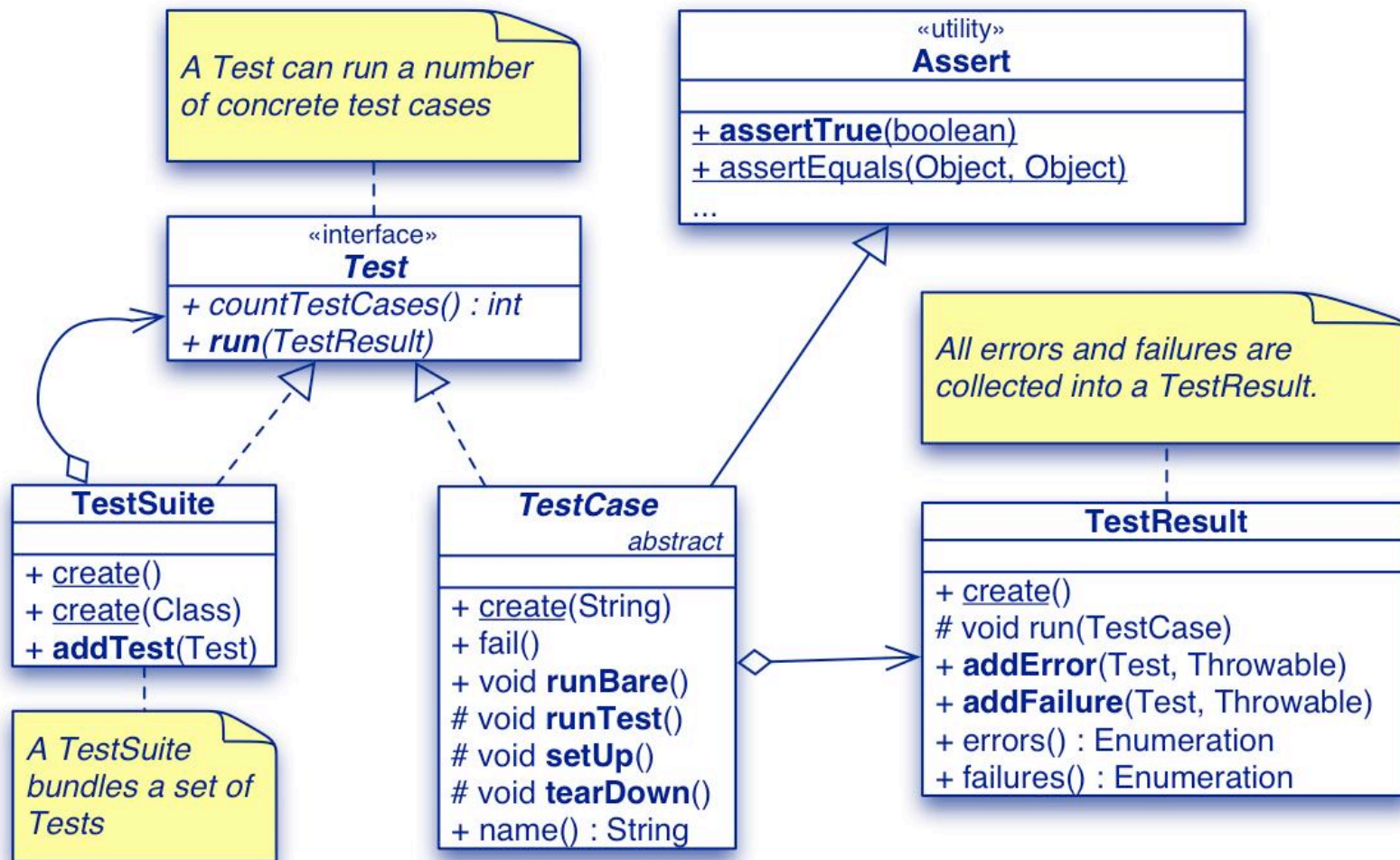


JUnit

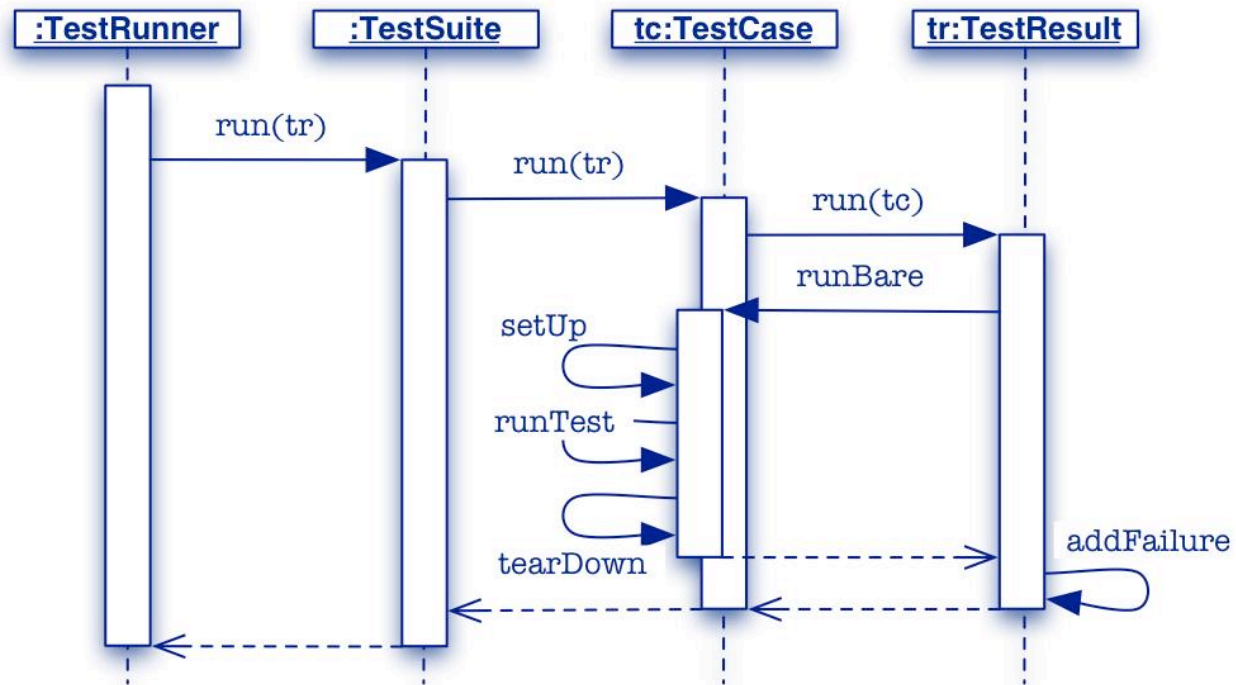
- Junit (inspired by SUnit) is a simple “testing framework” that provides:
 - classes for writing Test Cases and Test Suites
 - methods for setting up and cleaning up test data (“fixtures”)
 - methods for making assertions
 - textual and graphical tools for running tests



The JUnit Framework



A Testing Scenario



The framework calls the test methods that you define for your test cases.

SUnit

- Original framework



SetTestCase

Class: SetTestCase
superclass: TestCase

SetTestCase>>testAddition

| s |

s := Set new.

s add: 5; add: 3.

self **assert**: s size = 2.

s add: 5.

self **assert**: **s size = 2**



Duplicating the Context

SetTestCase>>testOccurrences

| empty |

empty := Set new.

self assert: (empty occurrencesOf: 0) = 0.

empty add: 5; add:5.

self assert: (empty occurrencesOf: 5) = 1



Testing Remove

```
SetTestCase>>testAddition
```

```
| s |
```

```
s := Set new.
```

```
s add: 6.
```

```
self assert: s size = 1.
```

```
s remove: 6.
```

```
self assert: s size = 0.
```

```
self should: [s remove: 1000] raise: Error.
```

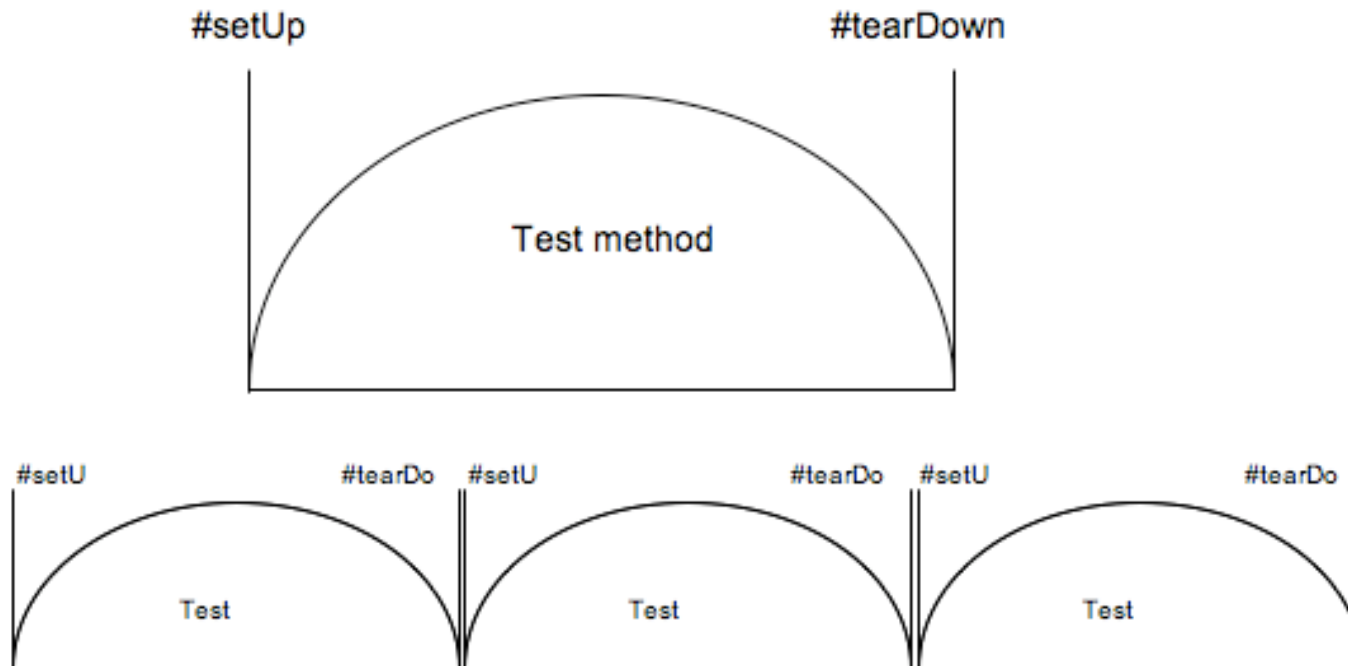
```
res := s remove: 5 ifAbsent: [33].
```

```
self assert: (res = 33)
```



setUp and TearDown

- Executed before and after each test
- setUp allows us to specify and reuse the context
- tearDown to clean after.



Example: Testing Set

- Class: SetTestCase
 superclass: TestCase
 instance variable: **'empty full'**
- SetTestCase >> **setUp**
 empty := Set new.
 full := Set with: 6 with: 5
- The **setUp** is the *context* in which each test is run.



Tests...

SetTestCase>>testAdd

empty add: 5.

self assert: (empty includes: 5).

SetTestCase>>testOccurrences

self assert: (empty occurrenceOf: 0) = 0.

self assert: (full occurrencesOf: 5) = 1.

full add: 5.

self assert: (full occurrencesOf: 5) = 1

SetTestCase>>testRemove

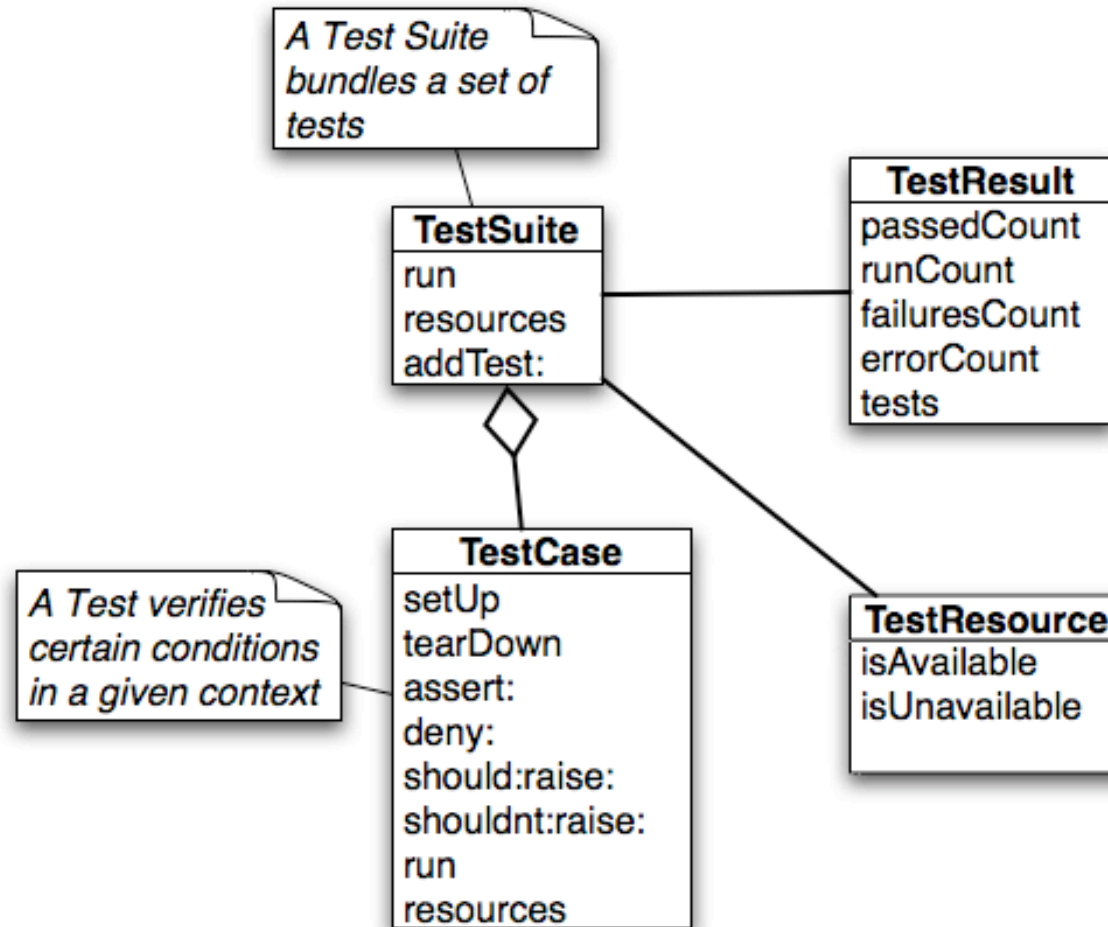
full remove: 5.

self assert: (full includes: 6).

self deny: (full includes: 5)



SUnit Core



TestSuite, TestCase and TestResult

a TestCase represents one test

SetTestCase>>testOccurenceOf

A testSuite is a group of tests

SUnit automatically builds a suite from the methods starting with 'test*'

TestResult represents a test execution results



Test Ressources

- A Test Resource is an object which is needed by a number of Test Cases, and whose instantiation is so costly in terms of time or resources that it becomes advantageous to only initialize it once for a Test Suite run.



TestResources

A TestResources is invoked once before any test is run.

Does not work if you have mutually exclusive TestResources.



Refactorings and Tests



What is Refactoring?

- The process of changing a software system in such a way that it does not alter the external behaviour of the code, yet improves its internal structure [Fowl99a]
- A behaviour-preserving source-to-source program transformation [Robe98a]
- A change to the system that leaves its behaviour unchanged, but enhances some non-functional quality - simplicity, flexibility, understandability, ... [Beck99a]

Typical Refactorings

List of refactorings provided by the refactoring browser

Class Refactorings	Method Refactorings	Attribute Refactorings
add (sub)class to hierarchy	add method to class	add variable to class
rename class	rename method	rename variable
remove class	remove method	remove variable
	push method down	push variable down
	push method up	pull variable up
	add parameter to method	create accessors
	move method to component	abstract variable
	extract code in new method	

Why Refactoring?

“Grow, don’t build software” Fred Brooks

- Some argue that good design does not lead to code needing refactoring,
- But in reality
 - Extremely difficult to get the design right the first time
 - You cannot fully understand the problem domain
 - You cannot understand user requirements, if he does!
 - You cannot really plan how the system will evolve in five years
 - Original design is often inadequate
 - System becomes brittle, difficult to change
- Refactoring helps you to
 - Manipulate code in a safe environment (behavior preserving)
 - Create an environment a situation where evolution is possible
 - Understand existing code

Refactor To Understand

Obvious

- Programs hard to read => Programs hard to understand => Programs hard to modify
- Programs with duplicated logic are hard to understand
- Programs with complex conditionals are hard to understand
- Programs hard to modify

Refactoring code creates and supports the understanding

- Renaming instance variables helps understanding methods
- Renaming methods helps understanding responsibility
- Iterations are *necessary*

The refactored code *does not* have to be used!



Test and Refactorings

- Tests can cover places where you have to manually change the code
 - Changing 3 by 33, nil but NewObject new
- Tests let you be more aggressive to change and improve your code



Summary



If you are serious about programming
If you do not have time to lose
If you want to have synchronized documentations

Write unit tests...