



# 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.                    "Context"
       empty add: 5.                        "Stimulus"
       self assert: (empty includes: 5).    "Check"

SetTestCase run: #testAdd
```



# Examples

```
testExampleRunArray3
   "this demonstrates that adjancent 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



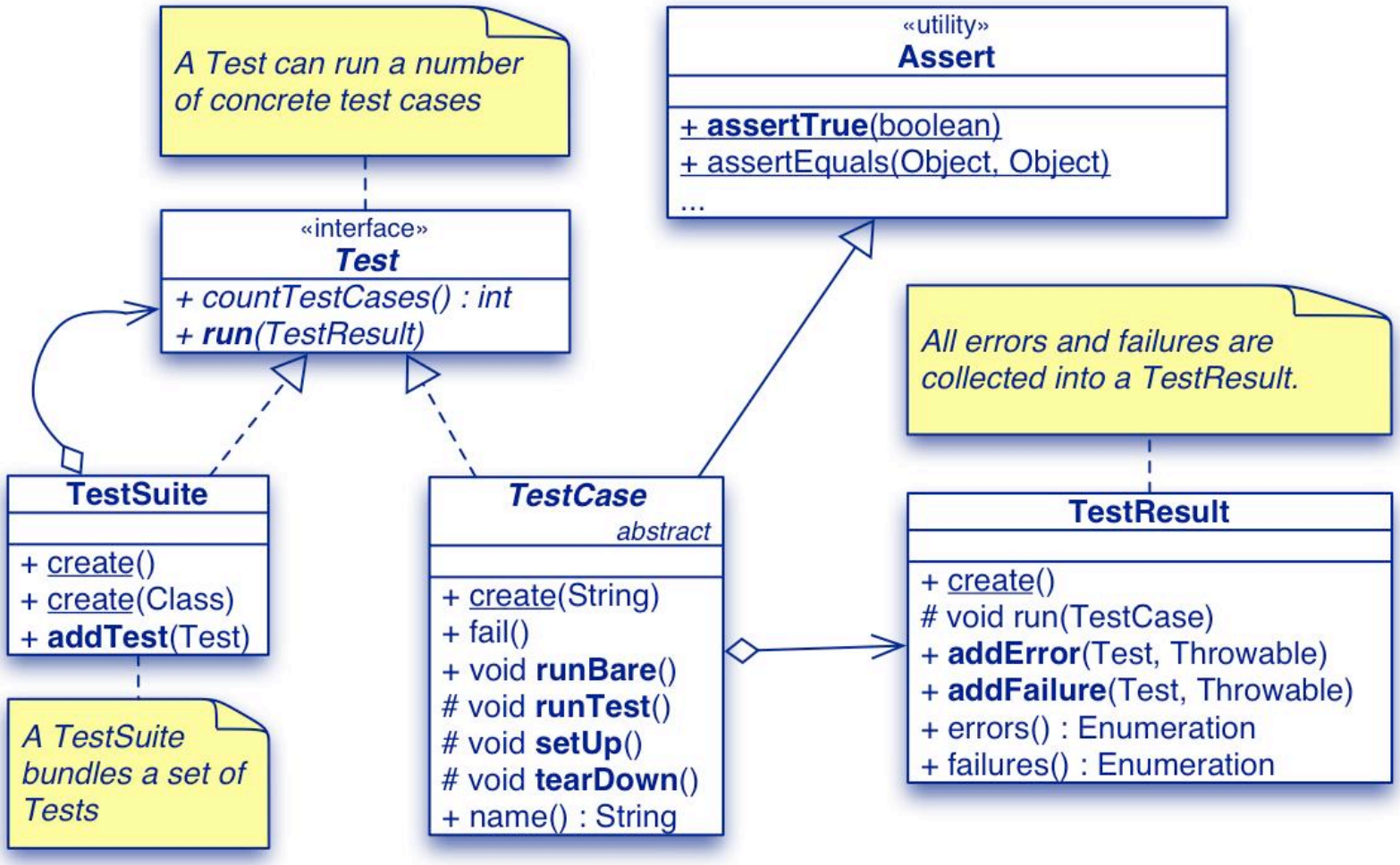
# JUnit

# JUnit

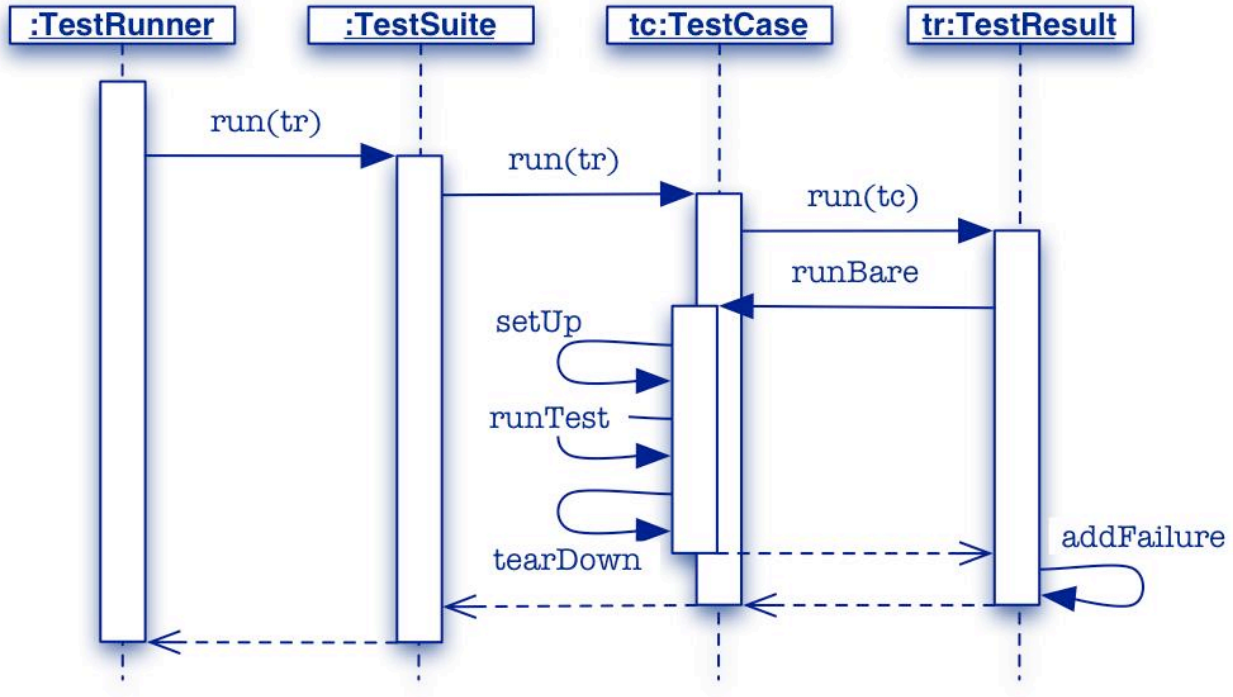
- Junit (inspired by Sunit) is a simple "testing framework" that provides:
  - classes for writing Test Cases and Test Suites
  - methods for setting up and cleaning up test data ("fixtures")
  - methods for making assertions
  - textual and graphical tools for running tests



# 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>>testAdd

```
| empty |
empty := Set new.
empty add: 5.
self assert: (empty includes: 5).
```



# Duplicating the Context

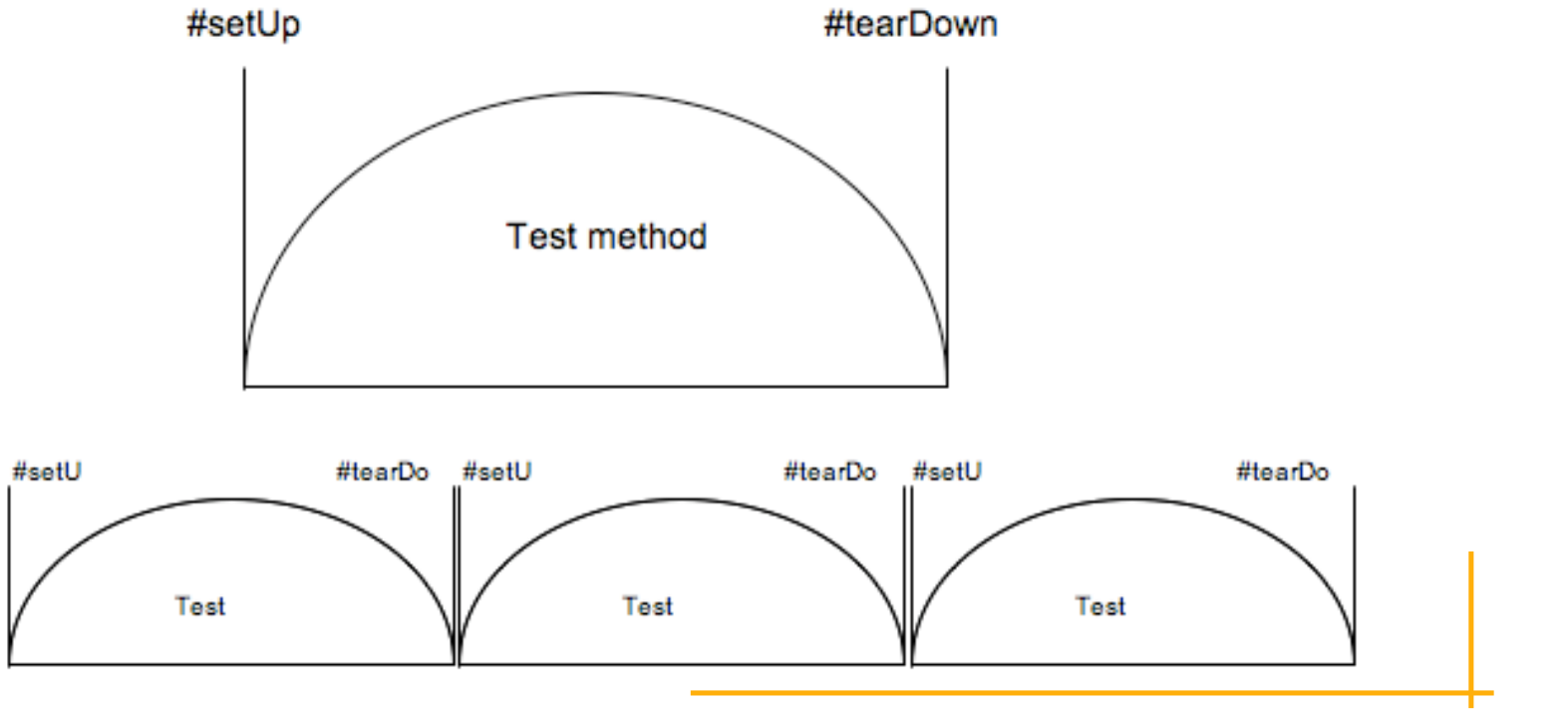
SetTestCase>>testOccurrences

```
| empty |
empty := Set new.
self assert: (empty occurrencesOf: 0) = 0.
empty add: 5; add:5.
self assert: (empty occurrencesOf: 5) = 1
```



# 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: #abc with: 5

- The setUp is the context in which each test is run.



# Tests…

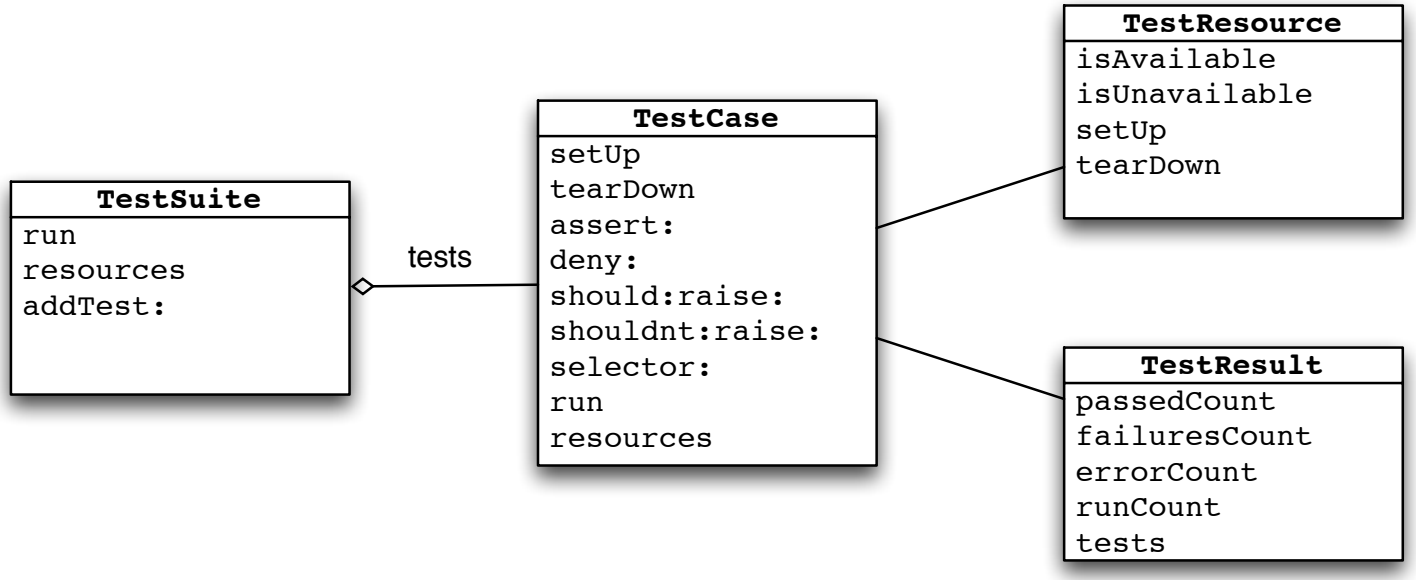
```
SetTestCase>>testAdd
        empty add: 5.
        self assert: (empty includes: 5).

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: #abc).
    self deny: (full includes: 5)
```



# SUnit Core


TestSuite
run
resources
addTest:
tests
TestCase
setUp
tearDown
assert:
deny:
should:raise:
shouldnt:raise:
selector:
run
resources
TestResource
isAvailable
isUnavailable
setUp
tearDown
TestResult
passedCount
failuresCount
errorCount
runCount
tests

# 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 been 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...