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# *SUnit Explained*

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Note for the reader: This article is a first draft version of the paper I would like to have. I would like to have a better motivation for testing, relations with XP and the latest version of SUnit 3.1. I wrote it because I could not afford to wait to have one document describing SUnit and the resources. This version has been sent to Squeak news. Originally Sam Shuster mentioned that he wanted to write an article on SUnit and I know that Joseph Pelrine as a paper under way. So if one of you is interested I would really like to have you as co-author.

SUnit is a minimal yet powerful framework that supports the creation of tests. SUnit was developed originally by Kent Beck and get extended by Joseph Pelrine and others over several iterations to take into account the notion of resources that we will illustrate hereafter. The interest for SUnit is not limited to Smalltalk or Squeak. Indeed legions of developers understood the power of unit testing and now versions of SUnit exist in nearly any language going from Java, Python, Perl, Oracle and lot others [SUnit]. The current version of SUnit is 3.0 and a new version 3.1 is on preparation.

Testing and building regression test suites is not new and everybody knows that regression tests are a good way to catch errors. Extreme Programming by putting testing in the core of its methodology is bringing a new light on testing which is a not so liked discipline. The Smalltalk community has a long tradition of test due to the incremental development supported by its programming environment. However, once you write tests in a workspace or as example methods there is no easy way to keep track of them and to automatically run them and tests that you cannot automatically run are of little interests. Moreover, having examples often does not tell to the reader what are the expect results, lot of the logic is left unspecified. That's why SUnit is interesting because it allows you to structure, describe the context of tests and to run them automatically. In less than two minutes you can write tests using SUnit instead of writing small code snippets and get all the advantage of stored and automatically executable tests.

In this article we start by discussing the interest of testing, then we present an exemple with SUnit and we go deep into the SUnit implementation.

## **1. Testing and Tests**

Most of the developers believe that tests are a lost of time. Who has not heard: "I would write tests if I would have more time". If you write code that should never be changed indeed you should not write tests, but this also means that you application is not really used or useful. In fact tests are an investment for the future. In particular, having a suite of tests is extremely useful and allow one to gain a lot of time when your application changes.

Tests play several roles: first they are an active and *always synchronized* documentation of the functionality they cover. Second they represent the confidence that developers can have into a piece of functionality. They help you to find extremely fast the parts that break to due introduced changes. It is obvious but simply true. Finally, writing tests in the same time or even be-

fore writing code force you to think about the functionality you want to design. By writing tests first you have to clearly state the context in which your functionality will run, the way it will interact and more important the expected results. Moreover, when you are writing tests you are your first client and your code will naturally improves.

The culture of tests has always been present in the Smalltalk community because a method is compiled and we write a small expression to test it. This practice supports the extremely tight incremental development cycle promoted by Smalltalk. However, doing so does not bring the maximum benefit from testing. Because tests are not stored, reachable and run automatically. Moreover it often happens that the context of the tests is left unspecified so the reader has to interpret the obtained results and assess they are right or wrong.

It is clear that we cannot tests all the aspects of an application. Covering a complete application is simply impossible and should not be goal of testing. It may also happen that even with a good test suite some bugs can creep into the application and be left hidden waiting for an opportunity to damage your system. This is not a problem as soon as if you trap a bug you write a test that covers it.

Writing good tests is a technique that can be easily learnt by practising. Let us look at the properties that tests should have to get a maximum benefit

- Repeatable. We should be able to repeat a test as much as we want.
- Without human intervention. Tests should be repeated without any human intervention. You should be able to run them during the night.
- Telling a story. A test should cover one aspect of a piece of code. A test should act as a scenario that you would like to read to understand a functionality.
- Having a change frequency lower than the one of the covered functionality. Indeed you do not want to change all your tests every times you modify your application. One way to achieve this property is to write tests based on the interfaces of the tested functionality.

Besides the property of the test itself another important point while writing test suites is that the number of tests should be somehow proportional to the number of tested functionality. For example, changing one aspect of the system should not break all the tests you wrote but only a limited number. This is important because having 100 tests broken should be a much more important message for you than having 10 tests failing.

eXtreme Programming proposes to write tests even before writing code. This may seems against our deep developer habits. Here are the observations we made while practising up front tests writing. Up front testing help to know what you want to code, they help to know when you are done, they help to conceptualize the functionality of a class and to design the interface. Now it is time to write a first test and to convince you that this is a pity not using SUnit.

## 2. SUnit by Example

Before going into the detail of SUnit, we show an example step by step. We use the example testing the class `Set` that is included in the SUnit distribution, so that you can read the code directly in your favorite Smalltalk.

**Step 1.** First you should subclass the `TestCase` class as follow:

```
TestCase subclass: #ExampleSetTest
```

```

instanceVariableNames: 'full empty'
classVariableNames: ''
poolDictionaries: ''
category: 'SUnit-Tests'

```

The class `ExampleSetTest` groups all tests related to the class test. It defines the context of all the tests that we will specify. Here the context is described by specifying two instance variables `full` and `empty` that represent a full and empty set.

**Step 2.** We define the method `setUp` as follow. The method `setUp` acts as a context definer method or initialize method. It is invoked before the execution of any test method defined in this class. Here we initialize the `empty` variable to refer to an empty set and the `full` variable to refer to a set containing two elements.

```

ExampleSetTest>>setUp
  empty := Set new.
  full := Set with: 5 with: #abc

```

This method defines the context of any tests defined in the class in testing jargon it is called the *fixture* of the test.

**Step 3.** We define some tests by defining some methods on the class `ExampleSetTest`. Basically one method represents one test. If your test methods start with the string `test` the framework will collect them automatically for you into test suites ready to be executed.

The first test named `testIncludes`, tests the `includes` method of a `Set`. We say that sending the message `includes: 5` to a set containing 5 should return `true`. Here we see clearly that the test relies on the fact that the `setUp` method has been run before.

```

ExampleSetTest>>testIncludes
  self assert: (full includes: 5).
  self assert: (full includes: #abc)

```

The second test named `testOccurrences` verifies that the occurrences of 5 in the full set is equal to one even if we add another element 5 to the set.

```

ExampleSetTest>>testOccurrences
  self assert: (empty occurrencesOf: 0) = 0.
  self assert: (full occurrencesOf: 5) = 1.
  full add: 5.
  self assert: (full occurrencesOf: 5) = 1

```

Finally we test that if we remove the element 5 from a set the set does not contain it any more.

```

ExampleSetTest>>testRemove
  full remove: 5.
  self assert: (full includes: #abc).
  self deny: (full includes: 5)

```

**Step 4.** Now we can execute the tests. This is possible using the user interface of `SUnit`. This interface depends on the dialect you use. In `Squeak` and `VisualWorks`, you should execute `TestRunner` open. You should obtain the figure 1. You can also run you tests by executing the fol-

lowing code: `(ExampleSetTest selector: #testRemove) run`. This expression is equivalent to the shorter one `ExampleSetTest run: #testRemove`. We usually always include such kind of expression in the comment of our tests to be able to run them while browsing them as shown below.

```
ExampleSetTest>>testRemove
  "self run: #testRemove"

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

To debug a test use the following expressions: `(ExampleSetTest selector: #testRemove) debug` or `ExampleSetTest debug: #testRemove`.



**Figure 1** The user interface of SUnit. Here a test run and all the tests passed.

**Some Explanations.** The method `assert:` which is defined on the class `TestCase` requires a boolean as argument. This boolean represents the value of a tested expression. When the argument is true, the expression is considered to be correct, we say that the test is valid. When the argument is false, then the test failed. In fact SUnit consider two kinds of errors: the failures, i.e., when a test is not valid and the errors which are unexpected situations occurring while the test is running. An error is by its nature something that has not been tested but that happened like an out of bounds error. The method `deny:` is the negation of `assert:`. Hence `aTest deny: anExpression` is equal to `aTest assert: anExpression not`.

SUnit offers two methods `should:raise:` and `shouldnt:raise:` (`aTest should: aBlock raise: anException`) to test that exceptions have been raised during the execution of an expression. The following test illustrates the use of this method.

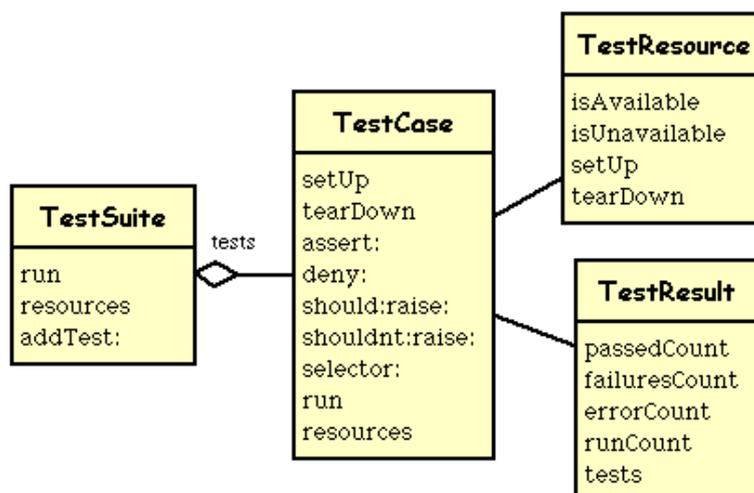
```
ExampleSetTest>>testIllegal
  self should: [empty at: 5] raise: Error.
  self should: [empty at: 5 put: #abc] raise: Error
```

Note that if you look in the example provided by SUnit you will find the following definition for the same test. Here the exception is provided via the `TestResult` class. This is because SUnit is running on all the Smalltalk dialects and the SUnit developers have factored out the variant part such as the name of the exception. So if you write tests that are intended to be cross dialects look at the class `TestResult`.

```
ExampleSetTest>>testIllegal
self should: [empty at: 5] raise: TestResult error.
self should: [empty at: 5 put: #abc] raise: TestResult error
```

### 3. The SUnit Framework

Squeak 3.1 includes the version 3.0 of SUnit. This version introduces the notion of resources that are mandatory when one needs to build tests that require long set up phases. A test resource specifies a set up that is only executed once for a set of tests contrary to the `TestCase` method which is executed before every test execution.



**Figure 2** The four classes representing the core of SUnit.

SUnit is constituted by four main classes, namely `TestCase`, `TestSuite`, `TestResult` et `TestResource` as shown in the figure 2.

The class `TestCase` represents a test or more generally a family of tests that share a common context. The context is specified by the declaration of instance variables on a subclass of `TestCase` and by the specialization of the method `setUp` which initializes the context in which the will be executed. The class `TestCase` defines also the method `tearDown` that is responsible for releasing if necessary the object allocated during the execution of the method `setUp`. The method `tearDown` is invoked after the execution of every tests.

The class `TestSuite` represents a collection of tests. An instance of `TestSuite` is composed by instance of `TestCase` subclasses (a instance of `TestCase` is characterized by the selector that should run) and `TestSuite`. The classes `TestSuite` and `TestCase` form a composite pattern in which `TestSuite` is the composite and `TestCase` the leaves.

The class `TestResult` represents the results of a `TestSuite` execution. This means the number of test passed, failed and the number of errors.

The class `TestResource` represents a resource that is used by a test or a set of tests. The point is that a resource is associated with subclass of `TestCase` and it is run automatically once before all the tests are executed contrary to the `TestCase` methods `setUp` and `tearDown` that are executed before and after any test.

A resource is run before a test suite is run. A resource is defined by specializing the class method `resources` as shown by the following example. By default, an instance of `TestSuite` consider that all its resources are the list of resources of the `TestCase` that compose it.

We define a subclass of `TestResource` called `MyTestResource` and we associate it with `MyTestCase` by specializing the class method `resources` to return an array of the test classes to which it is associated.

```
TestResource subclass: #MyTestResource
  instanceVariableNames: ''

TestResource>>setUp
  "here the resource is set up"

MyTestCase class>>resources
  "associate a resource with a testcase"

  ^ Array with: MyTestResource
```

As with a `TestCase`, we use the method `setUp` to define the actions that will be run during the set up of the resource.

## 4. Key Implementation Aspects

We show now some key aspects of the implementation by following the execution of a test. This is not mandatory to use SUnit but can help you to customize it.

**Running one Test.** To execute one test, we evaluate the expression `(TestCase selector: aSymbol) run`. The method `TestCase>>run` defined on the class `TestCase` creates an instance of `TestResult` that will contains the result of the executed tests, then it invokes the method `TestCase>>run:`

```
TestCase>>run
  | result |
  result := TestResult new.
  self run: result.
  ^result
```

The method `TestCase>>run:` invokes the method `TestResult>>runCase:` .

```
TestCase>>run: aResult
  aResult runCase: self
```

The method `TestResult>>runCase:` is the method that will invoke the method `TestCase>>runCase` that executes a test.

Without going into the details, `TestCase>>runCase` pays attention to the possible exception that may be raised during the execution of the test, invokes the execution of a test case by calling the method `runCase` and counts the errors, failures and passed tests.

```
TestResult>>runCase: aTestCase
| testCasePassed |
testCasePassed := true.
[[aTestCase runCase]
  sunitOn: self class failure
  do: [:signal |
    self failures add: aTestCase.
    testCasePassed := false.
    signal sunitExitWith: false]]
  sunitOn: self class error
  do: [:signal |
    self errors add: aTestCase.
    testCasePassed := false.
    signal sunitExitWith: false].
testCasePassed ifTrue: [self passed add: aTestCase]
```

The method `TestCase>>runCase` realizes the calls to the methods `setUp` et `tearDown` as shown below:

```
TestCase>>runCase
self setUp.
[self performTest] sunitEnsure: [self tearDown]
```

**Running a TestSuite.** To execute more than a test, we invoke the method `TestSuite>>run` on a `TestSuite`. The class `TestCase` provides some functionalities to get a test suite from its methods. The expression `MyTestCase buildSuiteFromSelectors` returns a suite containing all the tests defined in the class `MyTestCase`.

The method `TestSuite>>run` creates an instance of `TestResult`, verifies that all the resources are available, then the method `TestSuite>>run:` is invoked which runs all the tests that compose the test suite. All the resources are then reset.

```
TestSuite>>run
| result |
result := TestResult new.
self areAllResourcesAvailable
  ifFalse: [^TestResult signalErrorWith: 'Resource could not be initialized'].
[self run: result] sunitEnsure: [self resources do: [:each | each reset]].
^result
```

```
TestSuite>>run: aResult
self tests do: [:each |
  self sunitChanged: each.
  each run: aResult]
```

```
TestSuite>>areAllResourcesAvailable
^self resources
```

```
inject: true
into: [:total :each | each isAvailable & total]
```

The class `TestResource` and its subclasses keep track of their currently created instances (one per class) that can be accessed and created using the class method `current`. This instance is cleared when the tests have finished to run and the resources are reset.

This is during the resource availability check that the resource is created if needed as shows the class method `TestResource class>>isAvailable`. During the `TestResource` instance creation, it is initialized and the method `setUp` is invoked. (Note it may happen that your version of SUnit 3.0 does not correctly initialize the resource. A version with this bug circulated a lot. Verify that `TestResource class>>new` calls the method `initialize`).

```
TestResource class>>isAvailable
  ^self current notNil
TestResource class>>current
  current isNil ifTrue: [current := self new].
  ^current
TestResource>>initialize
  self setUp
```

## 5. Conclusion

We presented why writing tests are an important way of investing on the future. We recalled that tests should be repeatable, independent of any direct human interaction and cover a precise functionality to maximize their potential. We presented in a step by step fashion how to define a couple of tests for the class `Set` using SUnit. Then we gave an overview of the core of the framework by presenting the classes `TestCase`, `TestResult`, `TestSuite` and `TestResources`. Finally we dived into SUnit by following the execution of a tests and test suite. We hope that we convince you about the importance of repeatable unit tests and about the ease of writing them using SUnit.

## 6. Bibliography

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