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Effective Unit Testing

By
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Who am I?

- Principal Consultant, Pinnacle Solutions Group, Inc.
  - Senior Level consulting company specializing in Architecture and Development of Business Applications and Business Intelligence Solutions
- Microsoft MVP, MCSD.Net, MCDBA, CSM
- Enterprise Application Architect
- Trainer/Mentor
  - Creator of customized training for development teams
- National and Regional Speaker
- Director, Cincinnati .NET User's Group

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Development Environment

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- IDE = VS 2008 (C#)
  - ReSharper 4.5.xx
- Unit testing frameworks
  - Gallio/MbUnit 3.0.6.xx
  - JSSpec (JavaScript)
  - T-SQL Test Tool
- Mocking = Rhino Mocks 3.5, TypeMock
- Code Coverage = NCover 3
- Database = SQL Server 2008
- NHibernate 2.0.1

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Unit Testing Motivation

- Cost of correcting a defect (by phase)[1]:
  - *Requirements* = $139
  - *Design* = $455
  - *Coding* = $977
    - Unit testing targets coding -> deployment and maintenance
  - *System Testing* = $7,136
  - *Maintenance* = $14,102

[1]B.Boehm and V. Basili, "Software Defect Reduction Top 10 List", IEEE Computer, January 2001

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Agenda

- Unit Testing Definitions
- Unit Testing Patterns and Practices
- Code Demos

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Unit Testing Frameworks

- Tool used to run Unit Tests and provide feedback, either visually or as part of the build process
- .Net Frameworks (a few)
  - MbUnit, nUnit, xUnit, MSTest, etc
- JavaScript Frameworks
  - JSSpec
- SQL Server
  - T-SQL Test Tool

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Unit Tests

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- A procedure used to validate that individual units of source code are working properly[1].
  - A unit is the smallest testable part of an application.
    - Procedural Programming:
      - An individual program, function, or procedure
    - OOP:
      - Method which may belong to a base/super class, abstract class or derived/child class.

[1]Courtesy of Wikipedia

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The Law of Unit Testing

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- Each Unit Test is independent of any other unit test
- Each Unit Test leaves the System Under Test in the same state as before the test was executed
  - Otherwise, tests are not repeatable
  - Integration tests also need to follow this rule

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Types of Unit Tests

- State Testing
  - Easiest tests to write and execute
  - Asserted with value based semantics
    - AreEqual, IsNull, IsTrue, etc
  - Think *Stubs*
- Behavior-based Testing
  - Verification of Behavior of SUT
  - Achieved through mocking objects
  - Asserted via mocking frameworks
    - mockObject.VerifyAllExpectations()
  - Think *Mocks*

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Test Fixtures

- Object (Class) that provides context and specific resources to run one or more Unit Tests
- Can inherit from base Test Fixture
- Provide Specific method attributes for test runner
  - Class level
    - Fixture/FixtureSetUp/TearDown
  - Test Level
    - SetUp/TearDown/Test

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Test Fixtures Methods

- Fixture Methods – fire once per Test Fixture
  - FixtureSetup – before any tests
  - FixtureTearDown – after all tests
- Test Methods – fire once per test
  - SetUp – before each test
  - TearDown – after each test
- Test Attributes
  - Row(MbUnit/nUnit Extensions) – allows for seemless data driven testing
  - ExpectedException – to test exception paths
  - Ignore – should this be used?

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Code Coverage

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- Code Coverage
  - Quantifiable metric through tools
    - NCover, TFS, etc
  - Measures lines of code executed by the Unit Tests
  - For my teams, we target 80%
    - Opinions vary on the amount
    - Regardless of target, this should NOT be a management metric

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Use Case Coverage

- Use Case Coverage
  - Do the tests cover more than just the happy path?
  - Are exceptions and exception handling covered?
  - What about fringe cases?
    - Int.MaxValue, DateTime.MinValue, etc
  - Assert.AreEqual(4,Add(3,1))
    - Will pass if Add is hardcoded to return 4

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Mocks and Stubs[1]

- Mocks
  - Are pre-programmed with expectations
  - Used to verify the *behavior* of the system under test
    - Behavior is arranged in the Test
- Stubs
  - Provide canned answers to calls
  - Used to verify *state* of the system under test
    - State (result of calls) is predefined in the Stub

[1] http://martinfowler.com/articles/mocksArentStubs.html

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Why Mock Objects?

- Conditions that are difficult to reproduce
  - Specific time of day
  - A failing service
- Objects that are slow to execute or setup
  - Web service calls
  - Databases
- Objects that are not yet coded
- Objects that introduce noise that could occlude test results

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The "T"s and "D"s

- "TED" – Test Eventually Development
  - May be only way in certain situations (generated code)
  - Better than nothing, but not a "roadmap" to TDD
- "TDD" – Test Driven Development
  - Why we're here ☺
- "BDD" – Behavior Driven Development
  - TDD "done right"
- "DDD" – Domain Driven Design
  - An ally of TDD
  - Championed by Eric Evans, definitely worth investigating

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Solution/Project Structure

- Every Line Of Business (LOB) project should have a test project named [LOBName]Tests
  - DAL/DALTests
- Within the test project
  - Match Folder for Folder
  - Every Class in LOB project should have a Test Fixture name [LOBClassName]Tests

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Test Names

- Test Names should describe:
  - What is being tested
  - The condition being tested
  - The expected result
- Three schools of thought:
  - Sentence
    - Should_Return_Sum_When_Adding_Two_Integers
    - Should_Throw_When_Adding_With_Negative_Addend
  - Phrase (MethodTested_Action_Result)
    - Add_TwoIntegers_ReturnsResult
    - Add_NegativeInteger_ThrowsException
  - Given, When, Then
    - GivenTwoIntegers_WhenAdding_ThenReturnSum
    - GivenNegativeInteger_WhenAdding_ThenException

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Test Structure

- Unit Tests should follow the Arrange, Act, Assert pattern
  - Arrange
    - Setup system under test
    - Provide necessary data/dependencies
  - Act
    - Exercise the Unit of Code
  - Assert
    - Confirm the expected result
      - Sometimes, this is a non-change

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Dependency Injection

- AKA Inversion of Control
- Separates Client from instantiation/implementation of the Service
- Three methods
  - Constructor Injection
  - Setter Injection
  - Interface Injection
- Used to:
  - Create *seams* in the system under test to enable unit testing
  - Isolate the system under test to provide better testability

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Tracking (Test) To-Do's

- Keep list of tests||work items by workstation
  - Paper works best for me
    - Electronic impedes my rhythm
- As ideas come up, write them down
- Tackle them in order of confidence
- Cross them off when done
- Remember, Computers can multi-thread, people cannot

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Source Code Control

- Once all tests are green COMMIT (Check In) all code and tests
  - Immediately UPDATE (Get Latest)
  - Rerun all tests
- If change breaks multiple tests, REVERT
  - Often quicker than chasing the “white rabbit”

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Build Process

- Automated builds need to also run all unit tests
  - Builds should be run at least twice a day (striving towards Continuous Integration)
  - Failed Test = Failed Build = Doughnuts

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