O'REILLY
OSCON
Open Source Convention

Quality Assurance in PHP Projects

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Who I am

- Sebastian Bergmann
- Involved in the PHP Project since 2000
- Developer of PHPUnit
- Author, Consultant, Coach, Trainer

Quality Assurance in PHP Projects

Schedule

- 08:30am – 10:00am Tutorial
- 10:00am – 10:30am Coffee Break
- 10:30am – 12:00pm Tutorial

Quality Assurance in PHP Projects

Topics

- PHPUnit
  - Writing and running tests
  - Organizing tests into suites and groups
  - Refactoring, Test-Driven and Behaviour-Driven Development
  - Code Coverage

Quality Assurance in PHP Projects

Topics

- Selenium
  - Recording and running tests with Selenium IDE
  - Integrating PHPUnit with Selenium RC
- Continuous Integration
  - phpUnderControl
  - PHP_CodeSniffer

“Hot Topics” in PHP's History

From a Keynote by Derick Rethans

- Make it work
- Make it fast
- Make it scale
- Make it secure

Now that we know how to build applications that "just work", are fast and scalable, as well as secure, the next logical step is to implement processes and use techniques that help as assure that the software works correctly throughout the software's lifecycle.

Why test?

- Companies develop more and more enterprise-critical applications with PHP.
- Tests help to make sure that these applications work correctly.

What needs testing?

Web Application

- Backend
  - Business Logic
  - Reusable Components
- Frontend
  - Form Processing, Templates, ...
  - “Rich Interfaces” with AJAX, JSON, ...
  - Feeds, Web Services, ...

And how do we test it?

Web Application

- Backend
  - Functional Testing of the business logic with Unit Tests
  - Reusable Components
    - External components should have their own unit tests.
- Frontend
  - Acceptance Tests or System Tests that are run “in the browser”
  - Testing of feeds, web services, etc. with unit tests
  - Compatibility Tests for Operating System / Browser combinations
  - Performance Tests and Security Tests

Testing Software

- Component Tests
  - Executable code fragments, so called *Unit Tests*, test the correctness of parts, *units*, of the software (*system under test*)
- System Tests
  - Conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. (Wikipedia)
- Non-Functional Tests
  - Performance, Stability, Security, ...

Testing Software

- Developer Tests
  - Ensure that the code works correctly
- Acceptance Tests
  - Ensure that the code does what the customer wants

Test Tools

- To make (code) testing viable, good tool support is needed.
- This is where a testing framework such as PHPUnit comes into play.

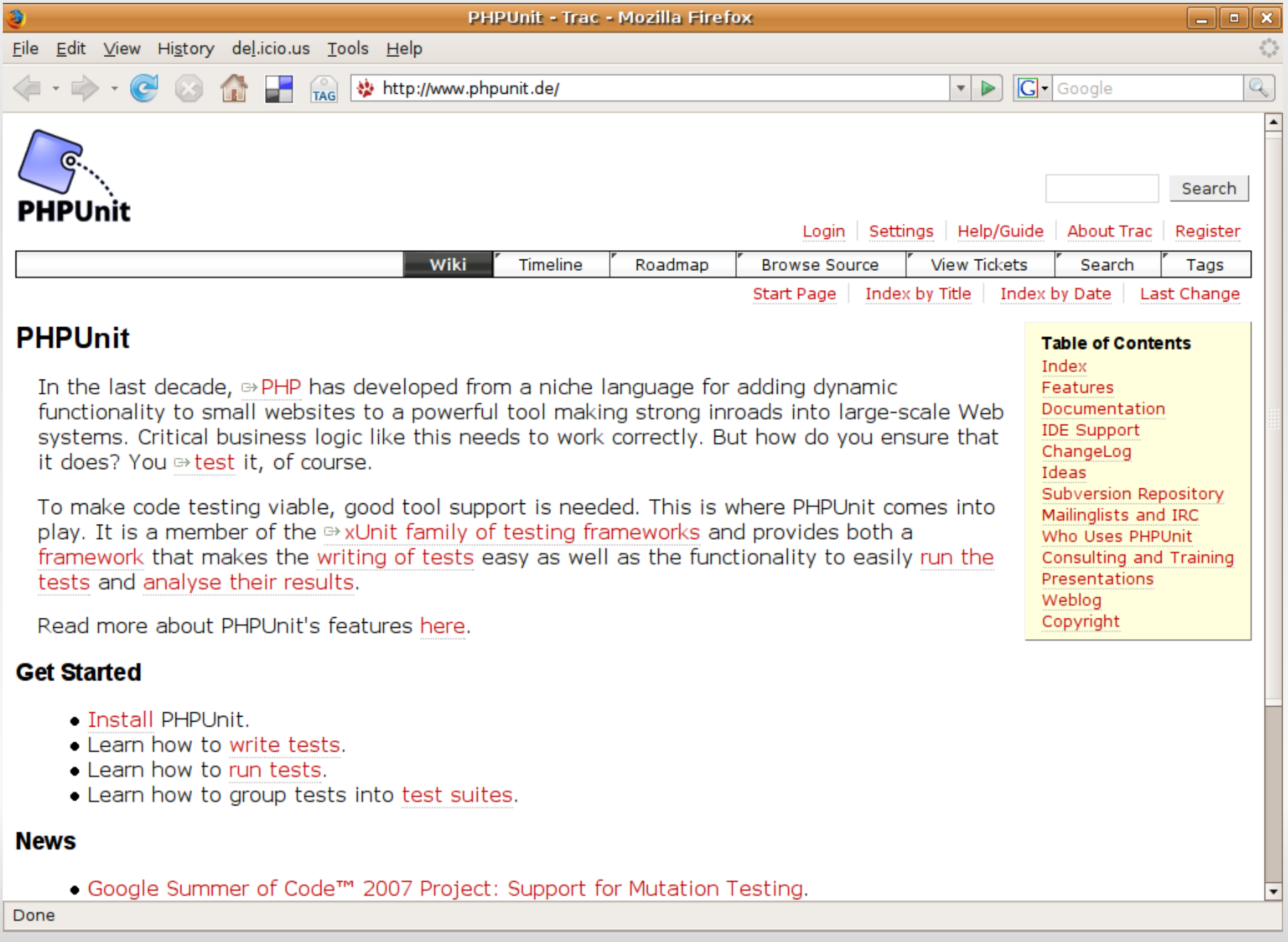
- Requirements
  - Reusable test environment
  - Strict separation of production code and test code
  - Automatic execution of test code
  - Analysis of the result
  - Easy to learn to use and easy to use

Test Tools for PHP / Web

- Unit Tests
  - PHPUnit
  - PHPT
  - SimpleTest
- System Tests
  - Selenium
    - PHPUnit + Selenium RC
- Non-Functional Tests
  - Performance, Load, Stress, Availability, ...
    - ab, httperf, JMeter, Grinder, OpenSTA, ...
  - Security
    - Chorizo

PHPUnit: Website

http://www.phpunit.de/



PHPUnit: Installation

```
sb@vmware ~ % pear channel-discover pear.phpunit.de
Adding Channel "pear.phpunit.de" succeeded
Discovery of channel "pear.phpunit.de" succeeded

sb@vmware ~ % pear install phpunit/PHPUnit
downloading PHPUnit-3.2.11.tgz ...
Starting to download PHPUnit-3.2.11.tgz (201,578 bytes)
.....................................done: 201,578 bytes
install ok: channel://pear.phpunit.de/PHPUnit-3.2.11
```

Outline

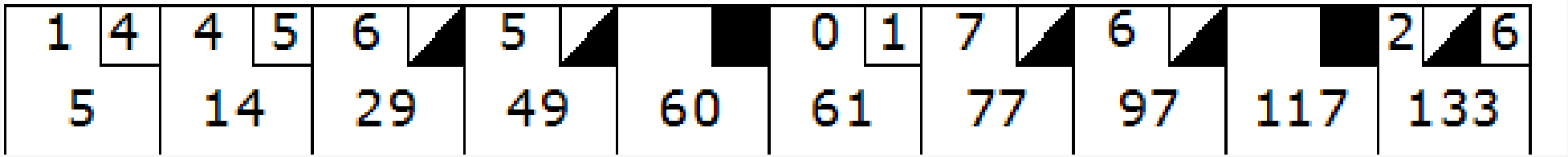
- PHPUnit
  - Writing tests
  - Running tests
- Selenium
  - Recording tests with the Selenium IDE
  - Running tests with PHPUnit and Selenium RC
- phpUnderControl
  - Continous Integration
  - Software Metrics

The Bowling Game Kata

Introduction: Scoring Bowling

The game consists of 10 frames as shown below.

- In each frame the player has two opportunities to knock down 10 pins.
- The score for the frame is the total number of pins knocked down, plus bonuses for strikes and spares.

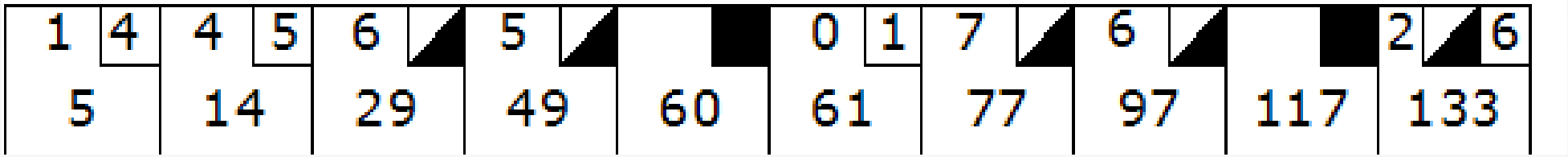


The Bowling Game Kata

Introduction: Scoring Bowling

A spare is when the player knocks down all 10 pins in two tries.

- The bonus for that frame is the number of pins knocked down by the next roll.
- So in frame 3 below, the score is 10 (the total number knocked down) plus a bonus of 5 (the number of pins knocked down on the next roll).

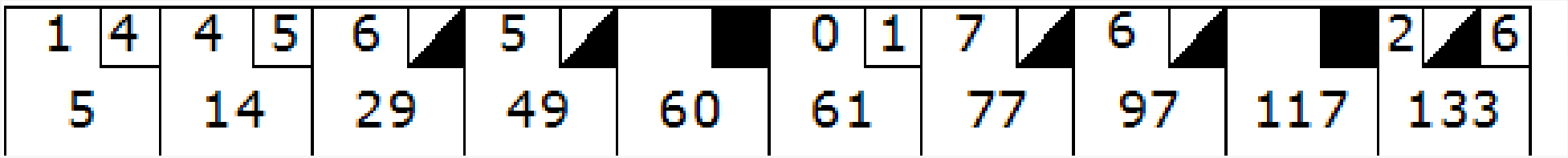


The Bowling Game Kata

Introduction: Scoring Bowling

A strike is when the player knocks down all 10 pins on his first try.

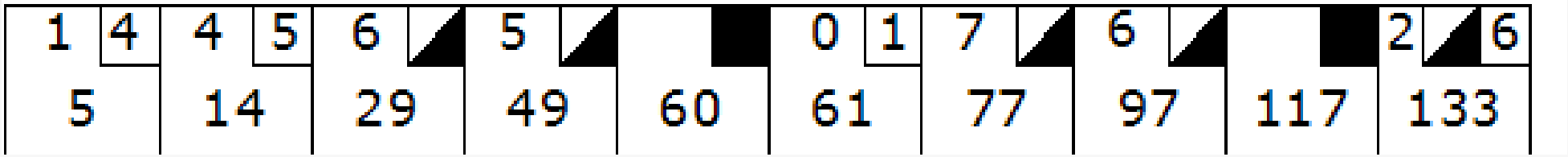
- The bonus for that frame is the value of the next two balls rolled.



The Bowling Game Kata

Introduction: Scoring Bowling

- In the tenth frame a player who rolls a spare or strike is allowed to roll the extra balls to complete the frame.
- However no more than three balls can be rolled in tenth frame.



The Bowling Game Kata

Introduction: Requirements

- Write a class named `BowlingGame` that has two methods
  - `roll($pins)` is called each time the player rolls a ball.
    - The argument is the number of pins knocked down.
  - `score()` is called only at the very end of the game and returns the total score for that game.

The Bowling Game Kata

Introduction: Design

- A game has 10 frames.
  - A frame has 1 or 2 rolls.
  - The 10^{th} frame has 2 or 3 rolls and is different from all the other frames.
- The `score()` method must iterate over all the frames and calculate all their scores.
  - The score for a spare or a strike depends on the frame's successor.

The Bowling Game Kata

The first test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{









}
```

The Bowling Game Kata

The first test

```
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    public function testGutterGame()
    {









    }
}
```

The Bowling Game Kata

The first test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    public function testGutterGame()
    {
        $game = new BowlingGame;

        for ($i = 0; $i < 20; $i++) {
            $game->roll(0);
        }

        $this->assertEquals(0, $game->score());
    }
}
```

The Bowling Game Kata

The first test

```php
<?php
class BowlingGame
{
    public function roll($pins)
    {
    }

    public function score()
    {
        return 0;
    }
}
```

The Bowling Game Kata

The first test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.

Time: 0 seconds


OK (1 test, 1 assertions)
```

The Bowling Game Kata

The first test

```
sb@vmware ~ % phpunit --ansi BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.

Time: 0 seconds


OK (1 test, 1 assertions)
```

Interlude

Test-Driven Development

- Method of designing software,
  not just a method of testing software
  - Test
    - What do we want *X* to do?
    - How do we want to tell *X* to do it?
    - How will we know when *X* has done it?
  - Code
    - How does *X* do it?
- Tests drive the development
  - Tests written before code
  - No code without tests

This slide contains material by Brady Kelly.

The Bowling Game Kata

The first test

```
sb@vmware ~ % phpunit --skeleton-class BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

Wrote skeleton for "BowlingGame" to "BowlingGame.php".
```

```php
<?php
class BowlingGame
{
    /**
     * @todo Implement roll().
     */
    public function roll()
    {
        // Remove the following line when you implement this method.
        throw new RuntimeException('Not yet implemented.');
    }

    /**
     * @todo Implement score().
     */
    public function score()
    {
        // Remove the following line when you implement this method.
        throw new RuntimeException('Not yet implemented.');
    }
}
?>
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testAllOnes()
    {
        $game = new BowlingGame;

        for ($i = 0; $i < 20; $i++) {
            $game->roll(1);
        }

        $this->assertEquals(20, $game->score());
    }
}
```

The Bowling Game Kata

The second test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.F

Time: 0 seconds

There was 1 failure:

1) testAllOnes(BowlingGameTest)
Failed asserting that <integer:0> matches expected value <integer:20>.
/home/sb/BowlingGameTest.php:25

FAILURES!
Tests: 2, Assertions: 2, Failures: 1.
```

The Bowling Game Kata

The second test

```
sb@vmware ~ % phpunit --ansi BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.F

Time: 0 seconds

There was 1 failure:

1) testAllOnes(BowlingGameTest)
Failed asserting that <integer:0> matches expected value <integer:20>.
/home/sb/BowlingGameTest.php:25

FAILURES!
Tests: 2, Assertions: 2, Failures: 1.
```

The Bowling Game Kata

The second test

```php
<?php
class BowlingGame
{
    protected $score = 0;

    public function roll($pins)
    {
        $this->score += $pins;
    }

    public function score()
    {
        return $this->score;
    }
}
```

The Bowling Game Kata

The second test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..

Time: 0 seconds


OK (2 tests, 2 assertions)
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testAllOnes()
    {
        $game = new BowlingGame;

        for ($i = 0; $i < 20; $i++) {
            $game->roll(1);
        }

        $this->assertEquals(20, $game->score());
    }
}
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testAllOnes()
    {
        $game = new BowlingGame;

        for ($i = 0; $i < 20; $i++) {
            $game->roll(1);
        }

        $this->assertEquals(20, $game->score());
    }
}
```

Interlude

Test Fixture

- One of the most time-consuming parts of writing tests is writing the code to set the world up in a known state and then return it to its original state when the test is complete.

- This known state is called the *fixture* of the test.

Interlude

Test Fixture

- In our `BowlingGameTest` example the test fixture was a single object.
- Most of the time, though, the fixture will be more complex than a simple object, and the amount of code needed to set it up will grow accordingly.
- The actual content of the test gets lost in the noise of setting up the fixture.
  - This problem gets even worse when you write several tests with similar fixtures.
- PHPUnit supports sharing the setup code through the `setUp()` and `tearDown()` template methods.

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    protected $game;

    protected function setUp()
    {
        $this->game = new BowlingGame;
    }

    // ...

    public function testAllOnes()
    {
        for ($i = 0; $i < 20; $i++) {
            $this->game->roll(1);
        }

        $this->assertEquals(20, $this->game->score());
    }

    // ...
}
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    protected $game;

    protected function setUp()
    {
        $this->game = new BowlingGame;
    }

    // ...

    public function testAllOnes()
    {
        for ($i = 0; $i < 20; $i++) {
            $this->game->roll(1);
        }

        $this->assertEquals(20, $this->game->score());
    }

    // ...
}
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    protected function rollMany($n, $pins)
    {
        for ($i = 0; $i < $n; $i++) {
            $this->game->roll($pins);
        }
    }

    public function testGutterGame()
    {
        $this->rollMany(20, 0);
        $this->assertEquals(0, $this->game->score());
    }

    public function testAllOnes()
    {
        $this->rollMany(20, 1);
        $this->assertEquals(20, $this->game->score());
    }
}
```

The Bowling Game Kata

The second test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    protected function rollMany($n, $pins)
    {
        for ($i = 0; $i < $n; $i++) {
            $this->game->roll($pins);
        }
    }

    public function testGutterGame()
    {
        $this->rollMany(20, 0);
        $this->assertEquals(0, $this->game->score());
    }

    public function testAllOnes()
    {
        $this->rollMany(20, 1);
        $this->assertEquals(20, $this->game->score());
    }
}
```

Interlude

Refactoring

A code refactoring is any change to a computer program's code which improves its readability or simplifies its structure without changing its results. (Wikipedia)

1. All unit tests run correctly.
2. The code communicates its design principles.
3. The code contains no redundancies.
4. The code contains the minimal number of classes and methods.

The Bowling Game Kata

The third test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testOneSpare()
    {
        $this->game->roll(5);
        $this->game->roll(5); // Spare
        $this->game->roll(3);
        $this->rollMany(17, 0);
        $this->assertEquals(16, $this->game->score());
    }
}
```

The Bowling Game Kata

The third test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..F

Time: 0 seconds

There was 1 failure:

1) testOneSpare(BowlingGameTest)
Failed asserting that <integer:13> matches expected value <integer:16>.
/home/sb/BowlingGameTest.php:38

FAILURES!
Tests: 3, Assertions: 3, Failures: 1.
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    protected $score = 0;


    public function roll($pins)
    {
        $this->score  += $pins;

    }

    public function score()
    {
        return $this->score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    protected $score = 0;
    protected $rolls = array();

    public function roll($pins)
    {
        $this->score  += $pins;
        $this->rolls[] = $pins;
    }

    public function score()
    {
        return $this->score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    protected $rolls = array();

    public function roll($pins)
    {
        $this->rolls[] = $pins;
    }

    public function score()
    {
        $score = 0;

        foreach ($this->rolls as $roll) {
            $score += $roll;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..F

Time: 0 seconds

There was 1 failure:

1) testOneSpare(BowlingGameTest)
Failed asserting that <integer:13> matches expected value <integer:16>.
/home/sb/BowlingGameTest.php:38

FAILURES!
Tests: 3, Assertions: 3, Failures: 1.
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score = 0;

        for ($i = 0; $i < count($this->rolls); $i++) {
            if ($this->rolls[$i] + $this->rolls[$i + 1] == 10) {
                // ...
            }

            $score += $this->rolls[$i];
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score = 0;
        $i     = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            $score += $this->rolls[$i] + $this->rolls[$i + 1];
            $i     += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..F

Time: 0 seconds

There was 1 failure:

1) testOneSpare(BowlingGameTest)
Failed asserting that <integer:13> matches expected value <integer:16>.
/home/sb/BowlingGameTest.php:38

FAILURES!
Tests: 3, Assertions: 3, Failures: 1.
```

The Bowling Game Kata

The third test

```
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score = 0;
        $i     = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Spare
            if ($this->rolls[$i] + $this->rolls[$i + 1] == 10) {
                $score += 10 + $this->rolls[$i + 2];
            } else {
                $score += $this->rolls[$i] + $this->rolls[$i + 1];
            }

            $i += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

...

Time: 0 seconds


OK (3 tests, 3 assertions)
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score = 0;
        $i     = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Spare
            if ($this->rolls[$i] + $this->rolls[$i + 1] == 10) {
                $score += 10 + $this->rolls[$i + 2];
            } else {
                $score += $this->rolls[$i] + $this->rolls[$i + 1];
            }

            $i += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score = 0;
        $i     = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Spare
            if ($this->rolls[$i] + $this->rolls[$i + 1] == 10) {
                $score += 10 + $this->rolls[$i + 2];
            } else {
                $score += $this->rolls[$i] + $this->rolls[$i + 1];
            }

            $i += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Spare
            if ($this->rolls[$frameIndex] + $this->rolls[$frameIndex + 1] == 10) {
                $score += 10 + $this->rolls[$frameIndex + 2];
            } else {
                $score += $this->rolls[$frameIndex] + $this->rolls[$frameIndex + 1];
            }

            $frameIndex += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            if ($this->isSpare($frameIndex)) {
                $score += 10 + $this->rolls[$frameIndex + 2];
            } else {
                $score += $this->rolls[$frameIndex] + $this->rolls[$frameIndex + 1];
            }

            $frameIndex += 2;
        }

        return $score;
    }

    protected function isSpare($frameIndex)
    {
        return $this->rolls[$frameIndex] + $this->rolls[$frameIndex + 1] == 10;
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testOneSpare()
    {
        $this->game->roll(5);
        $this->game->roll(5); // Spare
        $this->game->roll(3);
        $this->rollMany(17, 0);
        $this->assertEquals(16, $this->game->score());
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testOneSpare()
    {
        $this->game->roll(5);
        $this->game->roll(5); // Spare
        $this->game->roll(3);
        $this->rollMany(17, 0);
        $this->assertEquals(16, $this->game->score());
    }
}
```

The Bowling Game Kata

The third test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    protected function rollSpare()
    {
        $this->game->roll(5);
        $this->game->roll(5);
    }

    // ...

    public function testOneSpare()
    {
        $this->rollSpare();
        $this->game->roll(3);
        $this->rollMany(17, 0);
        $this->assertEquals(16, $this->game->score());
    }
}
```

The Bowling Game Kata

The fourth test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testOneStrike()
    {
        $this->game->roll(10); // Strike
        $this->game->roll(3);
        $this->game->roll(4);
        $this->rollMany(17, 0);
        $this->assertEquals(24, $this->game->score());
    }
}
```

The Bowling Game Kata

The fourth test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

...F

Time: 0 seconds

There was 1 failure:

1) testOneStrike(BowlingGameTest)
Failed asserting that <integer:17> matches expected value <integer:24>.
/home/sb/BowlingGameTest.php:52

FAILURES!
Tests: 4, Assertions: 4, Failures: 1.
```

The Bowling Game Kata

The fourth test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            if ($this->isSpare($frameIndex)) {
                $score += 10 + $this->rolls[$frameIndex + 2];
            }

            else {
                $score += $this->rolls[$frameIndex] + $this->rolls[$frameIndex + 1];
            }

            $frameIndex += 2;
        }

        return $score;
    }
}
```

The Bowling Game Kata

The fourth test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Strike
            if ($this->rolls[$frameIndex] == 10) {
                $score += 10
                       +  $this->rolls[$frameIndex + 1] + $this->rolls[$frameIndex + 2];
                $frameIndex++;
            }

            // ...
        }

        return $score;
    }
}
```

The Bowling Game Kata

The fourth test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

....

Time: 0 seconds


OK (4 tests, 4 assertions)
```

The Bowling Game Kata

The fourth test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            // Strike
            if ($this->rolls[$frameIndex] == 10) {
                $score += 10
                       +  $this->rolls[$frameIndex + 1] + $this->rolls[$frameIndex + 2];
                $frameIndex++;
            }

            // ...
        }

        return $score;
    }
}
```

The Bowling Game Kata

The fourth test

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            if ($this->isStrike($frameIndex)) {
                $score += 10
                       +  $this->rolls[$frameIndex + 1] + $this->rolls[$frameIndex + 2];
                $frameIndex++;
            }

            // ...
        }

        return $score;
    }

    protected function isStrike($frameIndex)
    {
        return $this->rolls[$frameIndex] == 10;
    }
}
```

The Bowling Game Kata

The fourth test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testOneStrike()
    {
        $this->game->roll(10); // Strike
        $this->game->roll(3);
        $this->game->roll(4);
        $this->rollMany(17, 0);
        $this->assertEquals(24, $this->game->score());
    }
}
```

The Bowling Game Kata

The fourth test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    protected function rollStrike()
    {
        $this->game->roll(10);
    }

    // ...

    public function testOneStrike()
    {
        $this->rollStrike();
        $this->game->roll(3);
        $this->game->roll(4);
        $this->rollMany(17, 0);
        $this->assertEquals(24, $this->game->score());
    }
}
```

The Bowling Game Kata

The fourth test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

....

Time: 0 seconds


OK (4 tests, 4 assertions)
```

The Bowling Game Kata

The fifth test

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testPerfectGame()
    {
        $this->rollMany(12, 10);
        $this->assertEquals(300, $this->game->score());
    }
}
```

The Bowling Game Kata

The fifth test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.....

Time: 0 seconds


OK (5 tests, 5 assertions)
```

The Bowling Game Kata

Final version of the BowlingGame class

```php
<?php
class BowlingGame
{
    protected $rolls = array();

    public function roll($pins)
    {
        $this->rolls[] = $pins;
    }

    // ...
}
```

The Bowling Game Kata

Final version of the BowlingGame class

```php
<?php
class BowlingGame
{
    // ...

    protected function isSpare($frameIndex)
    {
        return $this->sumOfPinsInFrame($frameIndex) == 10;
    }

    protected function isStrike($frameIndex)
    {
        return $this->rolls[$frameIndex] == 10;
    }

    protected function sumOfPinsInFrame($frameIndex)
    {
        return $this->rolls[$frameIndex] +
               $this->rolls[$frameIndex + 1];
    }
}
```

The Bowling Game Kata

Final version of the BowlingGame class

```php
<?php
class BowlingGame
{
    // ...

    protected function spareBonus($frameIndex)
    {
        return $this->rolls[$frameIndex + 2];
    }

    protected function strikeBonus($frameIndex)
    {
        return $this->rolls[$frameIndex + 1] +
               $this->rolls[$frameIndex + 2];
    }
}
```

The Bowling Game Kata

Final version of the BowlingGame class

```php
<?php
class BowlingGame
{
    // ...

    public function score()
    {
        $score      = 0;
        $frameIndex = 0;

        for ($frame = 0; $frame < 10; $frame++) {
            if ($this->isStrike($frameIndex)) {
                $score += 10 + $this->strikeBonus($frameIndex);
                $frameIndex++;
            }

            else if ($this->isSpare($frameIndex)) {
                $score += 10 + $this->spareBonus($frameIndex);
                $frameIndex += 2;
            }

            else {
                $score += $this->sumOfPinsInFrame($frameIndex);
                $frameIndex += 2;
            }
        }

        return $score;
    }
}
```

The Bowling Game Kata

The fifth test

```
sb@vmware ~ % phpunit BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.....

Time: 0 seconds


OK (5 tests, 5 assertions)
```

PHPUnit

Agile Documentation

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testGutterGame() { // ... }

    public function testAllOnes() { // ... }

    public function testOneSpare() { // ... }

    public function testOneStrike() { // ... }

    public function testPerfectGame() { // ... }
}
```

PHPUnit

Agile Documentation

```php
<?php
require_once 'BowlingGame.php';

class BowlingGameTest extends PHPUnit_Framework_TestCase
{
    // ...

    public function testScoreForGutterGameIs0() { // ... }

    public function testScoreForAllOnesIs20() { // ... }

    public function testScoreForOneSpareAnd3Is16() { // ... }

    public function testScoreForOneStrikeAnd3And4Is24() { // ... }

    public function testScoreForPerfectGameIs300() { // ... }
}
```

PHPUnit

Agile Documentation

```
sb@vmware ~ % phpunit --testdox BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

BowlingGame
 [x] Score for gutter game is 0
 [x] Score for all ones is 20
 [x] Score for one spare and 3 is 16
 [x] Score for one strike and 3 and 4 is 24
 [x] Score for perfect game is 300
```

Behaviour-Driven Development

- Extreme Programming originally had the rule to test everything that could possibly break
- Now, however, the practice of testing in Extreme Programming has evolved into Test-Driven Development
- But the tools still force developers to think in terms of tests and assertions instead of specifications

  A New Look At Test-Driven Development, Dave Astels. http://blog.daveastels.com/files/BDD_Intro.pdf

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{









}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {




    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {
        $this->given('New game')




    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {
        $this->given('New game')
             ->when('Player rolls', 5)



    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {
        $this->given('New game')
             ->when('Player rolls', 5)
             ->and('Player rolls', 5)


    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {
        $this->given('New game')
             ->when('Player rolls', 5)
             ->and('Player rolls', 5)
             ->and('Player rolls', 3)

    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    /**
     * @scenario
     */
    public function scoreForOneSpareAnd3Is16()
    {
        $this->given('New game')
             ->when('Player rolls', 5)
             ->and('Player rolls', 5)
             ->and('Player rolls', 3)
             ->then('Score should be', 16);
    }

    // ...
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    // ...

    public function runGiven(&$world, $action, $arguments)
    {
        switch($action) {
            case 'New game': {
                $world['game']  = new BowlingGame;
                $world['rolls'] = 0;
            }
            break;

            default: {
                return $this->notImplemented($action);
            }
        }
    }
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    // ...

    public function runWhen(&$world, $action, $arguments)
    {
        switch($action) {
            case 'Player rolls': {
                $world['game']->roll($arguments[0]);
                $world['rolls']++;
            }
            break;

            default: {
                return $this->notImplemented($action);
            }
        }
    }
}
```

Behaviour-Driven Development

```php
<?php
require_once 'PHPUnit/Extensions/Story/TestCase.php';
require_once 'BowlingGame.php';

class BowlingGameSpec extends PHPUnit_Extensions_Story_TestCase
{
    // ...

    public function runThen(&$world, $action, $arguments)
    {
        switch($action) {
            case 'Score should be': {
                for ($i = $world['rolls']; $i < 20; $i++) {
                    $world['game']->roll(0);
                }

                $this->assertEquals($arguments[0], $world['game']->score());
            }
            break;

            default: {
                return $this->notImplemented($action);
            }
        }
    }
}
```

Behaviour-Driven Development

```
sb@vmware ~ % phpunit --story BowlingGameSpec
PHPUnit 3.3.0 by Sebastian Bergmann.

BowlingGameSpec
 - Score for one spare and 3 is 16 [successful]

   Given New game
    When Player rolls 5
     and Player rolls 5
     and Player rolls 3
    Then Score should be 16

Scenarios: 1, Failed: 0, Skipped: 0, Incomplete: 0.
```

```
sb@vmware ~ % phpunit --testdox BowlingGameSpec
PHPUnit 3.3.0 by Sebastian Bergmann.

BowlingGameSpec
 [x] Score for one spare and 3 is 16
```

PHPUnit

Code Coverage

```
sb@vmware ~ % phpunit --coverage-html report BowlingGameTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.....

Time: 0 seconds


OK (5 tests)

Generating report, this may take a moment.
```

Organizing Test Suites

- Application/
  - Package/
    - Application_Package_Class
      Application/Package/Class.php
    - ...
  - ...
  - Tests/
    - AllTests.php
    - Package/
      - AllTests.php
      - Application_Package_ClassTest
        Application/Tests/Package/ClassTest.php

Organizing Test Suites

Application/Tests/AllTests.php

```php
<?php
require_once 'PHPUnit/Framework.php';

require_once 'Application/Tests/Package/AllTests.php';

class AllTests
{
    public static function suite()
    {
        $suite = new PHPUnit_Framework_TestSuite('Project');
        $suite->addTest(Package_AllTests::suite());

        return $suite;
    }
}
?>
```

Organizing Test Suites

Application/Tests/Package/AllTests.php

```php
<?php
require_once 'PHPUnit/Framework.php';

require_once 'Application/Tests/Package/ClassTest.php';

class Package_AllTests
{
    public static function suite()
    {
        $suite = new PHPUnit_Framework_TestSuite('Package');
        $suite->addTestSuite('Package_ClassTest');

        return $suite;
    }
}
?>
```

Organizing Test Suites

Application/Tests/Package/ClassTest.php

```php
<?php
require_once 'PHPUnit/Framework.php';

require_once 'Application/Package/ClassTest.php';

class Package_ClassTest extends PHPUnit_Framework_TestCase
{
    public function testSomething()
    {
        // ...
    }
}
?>
```

Organizing Test Suites

Running the tests

- Executing `phpunit AllTests` in the `Tests` directory will run all tests.
- Executing `phpunit AllTests` in the Tests/Package directory will run only the tests for the `Application_Package_*` classes.
- Executing `phpunit ClassTest` in the `Tests/Framework` directory will run only the tests for the Application_Package_Class class (which are declared in the Package_ClassTest class).
- Executing `phpunit --filter testSomething ClassTest` in the `Tests/Package` directory will run only the test named `testSomething` from the `Package_ClassTest` class.

Organizing Test Suites

The @group annotation

```
<?php
class SomeTest extends PHPUnit_Framework_TestCase
{
    /**
     * @group specification
     */
    public function testSomething()
    {
    }

    /**
     * @group regresssion
     * @group bug2204
     */
    public function testSomethingElse()
    {
    }
}
```

Organizing Test Suites

The @group annotation

```
sb@vmware ~ % phpunit SomeTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..

Time: 0 seconds


OK (2 tests, 2 assertions)
```

```
sb@vmware ~ % phpunit --group bug2204 SomeTest
PHPUnit 3.3.0 by Sebastian Bergmann.

.

Time: 0 seconds


OK (1 test, 1 assertion)
```

Annotations

@dataProvider

```php
<?php
class DataTest extends PHPUnit_Framework_TestCase
{
    /**
     * @dataProvider providerMethod
     */
    public function testAdd($a, $b, $c)
    {
        $this->assertEquals($c, $a + $b);
    }

    public function providerMethod()
    {
        return array(
          array(0, 0, 0),
          array(0, 1, 1),
          array(1, 1, 3),
          array(1, 0, 1)
        );
    }
}
```

Annotations

@dataProvider

```
sb@vmware ~ % phpunit DataTest
PHPUnit 3.3.0 by Sebastian Bergmann.

..F.

Time: 0 seconds

There was 1 failure:

1) testAdd(DataTest) with data (1, 1, 3)
Failed asserting that <integer:2> matches expected
value <integer:3>.
/home/sb/DataTest.php:19

FAILURES!
Tests: 4, Assertions: 4, Failures: 1.
```

Annotations

@expectedException

```php
<?php
class ExceptionTest extends PHPUnit_Framework_TestCase
{
    /**
     * @expectedException InvalidArgumentException
     */
    public function testException()
    {
    }
}
```

Annotations

@expectedException

```
sb@vmware ~ % phpunit ExceptionTest
PHPUnit 3.3.0 by Sebastian Bergmann.

F

Time: 0 seconds

There was 1 failure:

1) testException(ExceptionTest)
Expected exception InvalidArgumentException

FAILURES!
Tests: 1, Assertions: 1, Failures: 1.
```

Annotations

@test

```php
<?php
class Specification extends PHPUnit_Framework_TestCase
{
    /**
     * @test
     */
    public function shouldDoSomething()
    {
    }

    /**
     * @test
     */
    public function shouldDoSomethingElse()
    {
    }
}
```

Annotations

@test

```
sb@vmware ~ % phpunit --testdox Specification
PHPUnit 3.3.0 by Sebastian Bergmann.

Specification
 [x] Should do something
 [x] Should do something else
```

Annotations

@assert

```php
<?php
class Calculator
{
    /**
     * @assert (1, 2) == 3
     */
    public function add($a, $b)
    {
        return $a + $b;
    }

    /**
     * @assert (2, 1) == 1
     */
    public function sub($a, $b)
    {
        return $a - $b;
    }
}
```

Annotations

@assert

```
sb@vmware ~ % phpunit Calculator
PHPUnit 3.3.0 by Sebastian Bergmann.

..

Time: 0 seconds


OK (2 tests, 2 assertions)
```

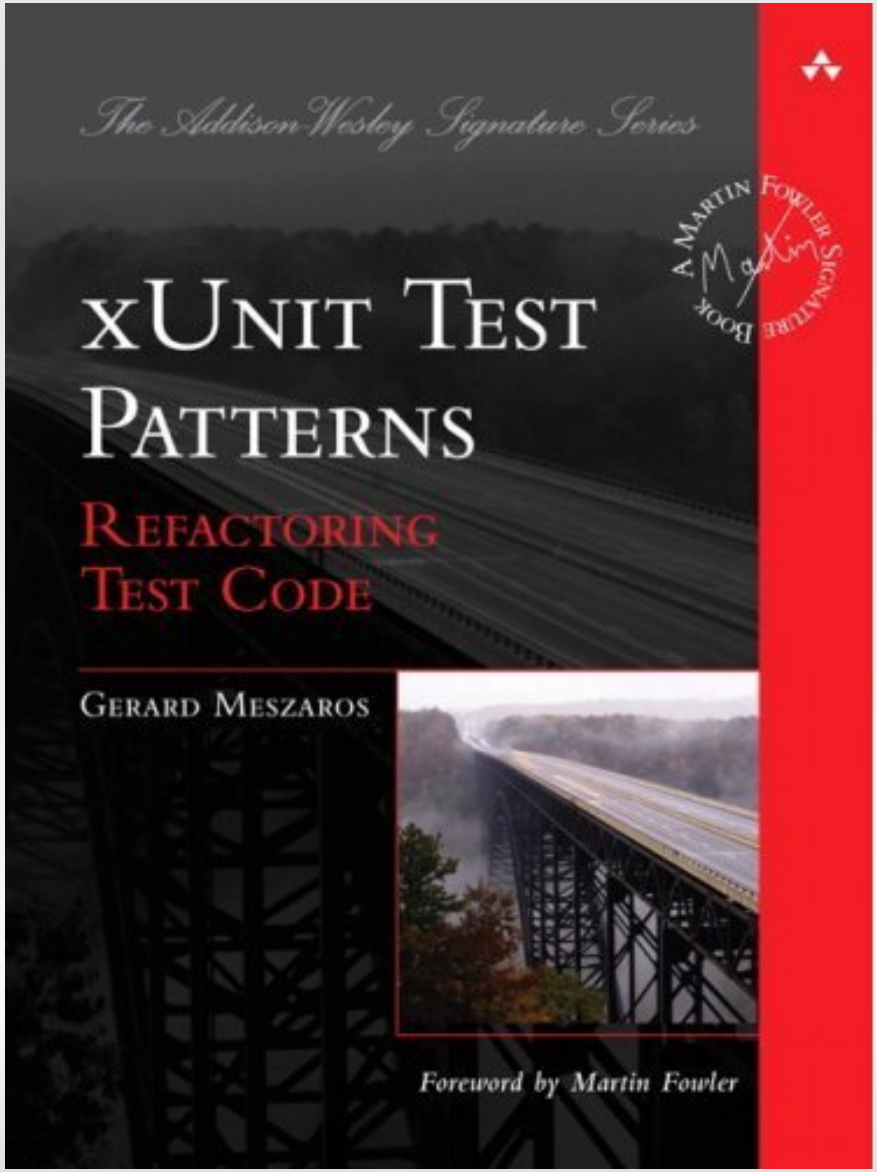
Test Doubles

- *How can we verify logic independently when code it depends on is unusable?*
- *How can we avoid slow tests?*
- **We replace a component on which the SUT depends with a “test-specific equivalent”.**

Test Doubles

Terminology

- Dummy
  - Not the real object
- Fake
  - Usable for testing but not for real job
- Stub
  - Fake that returns canned data
- Spy
  - Stub that records called methods, etc.
- Mock
  - Spy with expectations



Test Doubles

Stubs

```php
<?php
require_once 'PHPUnit/Framework.php';

class StubTest extends PHPUnit_Framework_TestCase
{
    public function testStub()
    {



    }
}
?>
```

Test Doubles

Stubs

```php
<?php
require_once 'PHPUnit/Framework.php';

class StubTest extends PHPUnit_Framework_TestCase
{
    public function testStub()
    {
        $stub = $this->getMock('SomeClass');









    }
}
?>
```

Test Doubles

Stubs: returnValue()

```php
<?php
require_once 'PHPUnit/Framework.php';

class StubTest extends PHPUnit_Framework_TestCase
{
    public function testStub()
    {
        $stub = $this->getMock('SomeClass');
        $stub->expects($this->any())
             ->method('doSomething')
             ->will($this->returnValue('foo'));



    }
}
?>
```

Test Doubles

Stubs: returnValue()

```php
<?php
require_once 'PHPUnit/Framework.php';

class StubTest extends PHPUnit_Framework_TestCase
{
    public function testStub()
    {
        $stub = $this->getMock('SomeClass');
        $stub->expects($this->any())
             ->method('doSomething')
             ->will($this->returnValue('foo'));

        // Calling $stub->doSomething() will now return
        // 'foo'.
    }
}
?>
```

Test Doubles

Stubs: returnArgument()

```php
<?php
class StubTest extends PHPUnit_Framework_TestCase
{
    public function testReturnArgumentStub()
    {
        $stub = $this->getMock(
          'SomeClass', array('doSomething')
        );

        $stub->expects($this->any())
             ->method('doSomething')
             ->will($this->returnArgument(0));

        // $stub->doSomething('foo') returns 'foo'
        // $stub->doSomething('bar') returns 'bar'
    }
}
```

Test Doubles

Stubs: returnCallback()

```php
<?php
class StubTest extends PHPUnit_Framework_TestCase
{
    public function testReturnCallbackStub()
    {
        $stub = $this->getMock(
          'SomeClass', array('doSomething')
        );

        $stub->expects($this->any())
             ->method('doSomething')
             ->will($this->returnCallback('callback'));

        // $stub->doSomething() returns callback(...)
    }
}

function callback() {
    $args = func_get_args();
    // ...
}
```

Test Doubles

Stubs: throwException()

```php
<?php
class StubTest extends PHPUnit_Framework_TestCase
{
    public function testThrowExceptionStub()
    {
        $stub = $this->getMock(
          'SomeClass', array('doSomething')
        );

        $stub->expects($this->any())
             ->method('doSomething')
             ->will($this->throwException(new Exception));

        // $stub->doSomething() throws Exception
    }
}
```

Test Doubles

Mock Objects

```php
<?php
require_once 'PHPUnit/Framework.php';

class ObserverTest extends PHPUnit_Framework_TestCase {
    public function testUpdateIsCalledOnce() {









    }
}
?>
```

Test Doubles

Mock Objects

```php
<?php
require_once 'PHPUnit/Framework.php';

class ObserverTest extends PHPUnit_Framework_TestCase {
    public function testUpdateIsCalledOnce() {
        $observer = $this->getMock(
          'Observer', array('update')
        );









    }
}
?>
```

Test Doubles

Mock Objects

```php
<?php
require_once 'PHPUnit/Framework.php';

class ObserverTest extends PHPUnit_Framework_TestCase {
    public function testUpdateIsCalledOnce() {
        $observer = $this->getMock(
          'Observer', array('update')
        );

        $observer->expects($this->once())
                 ->method('update')
                 ->with($this->equalTo('something'));



    }
}
?>
```

Test Doubles

Mock Objects

```php
<?php
require_once 'PHPUnit/Framework.php';

class ObserverTest extends PHPUnit_Framework_TestCase {
    public function testUpdateIsCalledOnce() {
        $observer = $this->getMock(
          'Observer', array('update')
        );

        $observer->expects($this->once())
                 ->method('update')
                 ->with($this->equalTo('something'));

        $subject = new Subject;
        $subject->attach($observer);
        $subject->doSomething();
    }
}
?>
```

DbUnit

- Michael Lively Jr. has ported the DbUnit extension for JUnit to PHPUnit
  - PHPUnit_Extensions_Database_TestCase
    - is used to test database-driven projects and
    - puts your database into a known state between test runs
      - This avoids problems with one test corrupting the database for other tests
    - has the ability to export and import your database data to and from XML datasets

DbUnit

- DbUnit uses PDO to connect to the database-under-test
- The tested application does not have to use PDO itself for this to work
  - You can therefore use ext/mysqli in your application and ext/pdo_mysql in your tests, for instance

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {

}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    protected $pdo;

    public function __construct() {
        $this->pdo = PHPUnit_Util_PDO::factory(
          'mysql://test@localhost/test'
        );

        BankAccount::createTable($this->pdo);
    }









}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    protected $pdo;

    public function __construct() {
        $this->pdo = PHPUnit_Util_PDO::factory(
          'mysql://test@localhost/test'
        );

        BankAccount::createTable($this->pdo);
    }

    protected function getConnection() {
        return $this->createDefaultDBConnection($this->pdo, 'mysql');
    }



}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    protected $pdo;

    public function __construct() {
        $this->pdo = PHPUnit_Util_PDO::factory(
          'mysql://test@localhost/test'
        );

        BankAccount::createTable($this->pdo);
    }

    protected function getConnection() {
        return $this->createDefaultDBConnection($this->pdo, 'mysql');
    }

    protected function getDataSet() {
        return $this->createFlatXMLDataSet('/path/to/seed.xml');
    }
}
```

DbUnit

seed.xml

```
<dataset>
  <account account_number="1593490364962048" balance="100.00" />
  <account account_number="1593648723021506" balance="1216.00" />
  <account account_number="1234861235723618" balance="89.00" />
  <account account_number="1593648723021506" balance="1216.00" />
</dataset>
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    // ...

    public function testNewAccount() {









    }
}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    // ...

    public function testNewAccount() {
        $ba = new BankAccountDB('1234567891234567', $this->pdo);









    }
}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    // ...

    public function testNewAccount() {
        $ba = new BankAccountDB('1234567891234567', $this->pdo);

        $set = $this->createFlatXMLDataSet(
          '/path/to/after-new-account.xml'
        );









    }
}
```

DbUnit

BankAccountDBTest.php

```php
<?php
require_once 'PHPUnit/Extensions/Database/TestCase.php';

class BankAccountDBTest extends PHPUnit_Extensions_Database_TestCase {
    // ...

    public function testNewAccount() {
        $ba = new BankAccountDB('1234567891234567', $this->pdo);

        $set = $this->createFlatXMLDataSet(
          '/path/to/after-new-account.xml'
        );

        $this->assertTablesEqual(
          $set->getTable('account'),
          $this->getConnection()
               ->createDataSet()
               ->getTable('account')
        );
    }
}
```

DbUnit

after-new-account.xml

```
<dataset>
  <account account_number="1593490364962048" balance="100.00" />
  <account account_number="1593648723021506" balance="1216.00" />
  <account account_number="1234861235723618" balance="89.00" />
  <account account_number="1593648723021506" balance="1216.00" />
  <account account_number="1234567891234567" balance="0.00" />
</dataset>
```

Test against SQLite if you can

- When testing PHP code that uses PDO to connect to a database, it makes sense to keep your SQL compatible with SQLite
  - No server ⇒ No inter-process communication
  - In-Memory Databases ⇒ No Disk I/O

	User	System	CPU	Total
PDO / MySQL	3.95s	0.87s	40%	12.046s
PDO / SQLite (file)	5.01s	1.54s	63%	10.359s
PDO / SQLite (memory)	3.16s	0.68s	99%	3.849s

Selenium

- Selenium
  - Test web applications in a web browser
    - Browser Compatibility Testing
    - System Functional Testing
  - Runs in the browser
- Selenium IDE
  - IDE for Selenium tests
    - Extension for Firefox
    - Record, execute, edit, debug tests in the browser

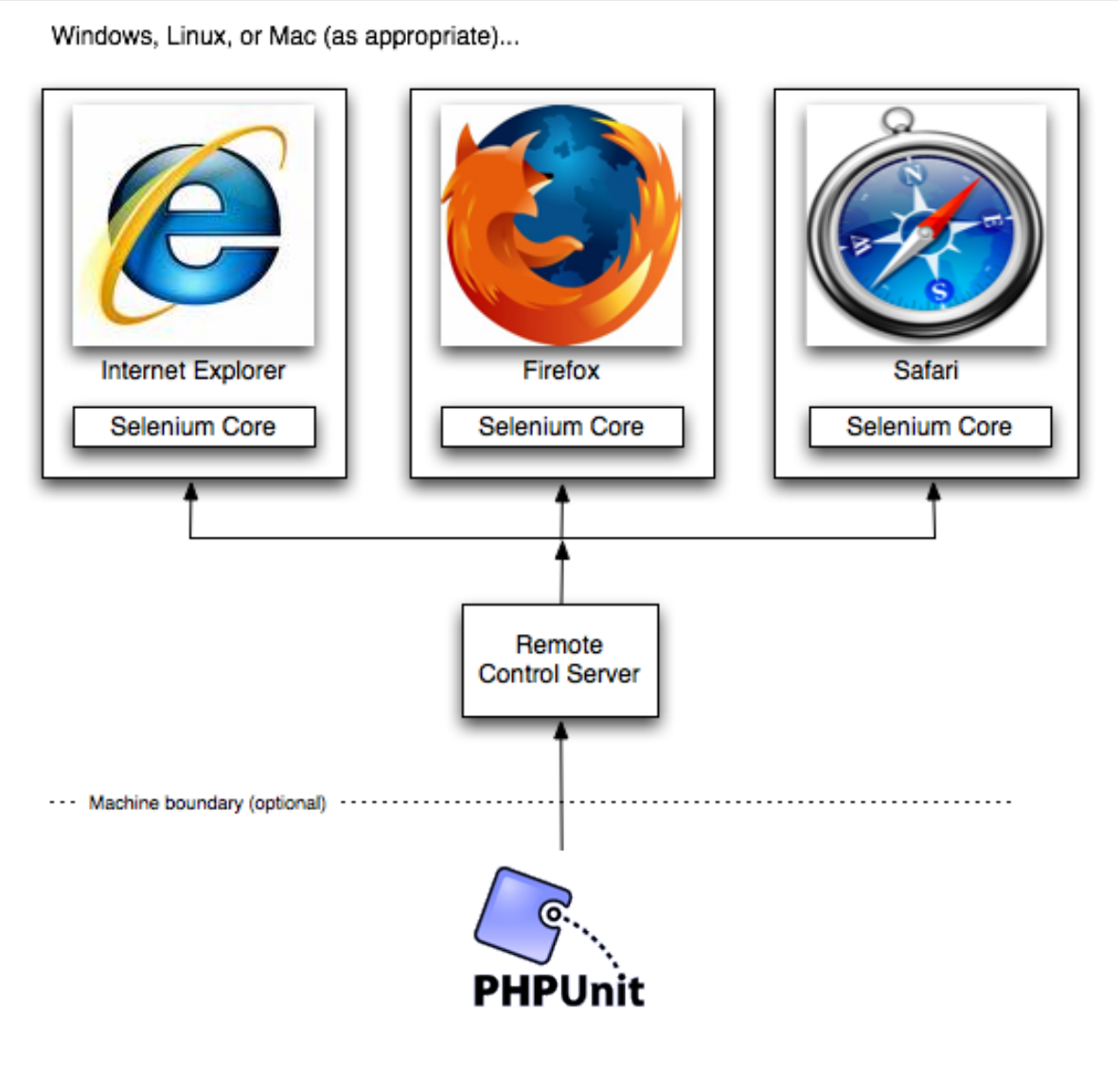
Selenium

Selenium RC

- Selenium RC
  - Automated execution of Selenium tests
  - Tests can be specified in any language
    - PHP Bindings: PEAR Testing_Selenium
    - PHPUnit natively speaks the Selenium RC protocol
  - One test can be executed on multiple OS / Browser combinations

Selenium

Selenium RC



Continuous Integration

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Continuous Integration

- Software development practice where members of a team integrate their work frequently
  - Usually each person integrates at least daily, leading to multiple integrations per day
- Each integration is verified by an automated build (including test) to detect integration errors as quickly as possible
- This approach leads to significantly reduced integration problems and allows a team to develop cohesive software more rapidly

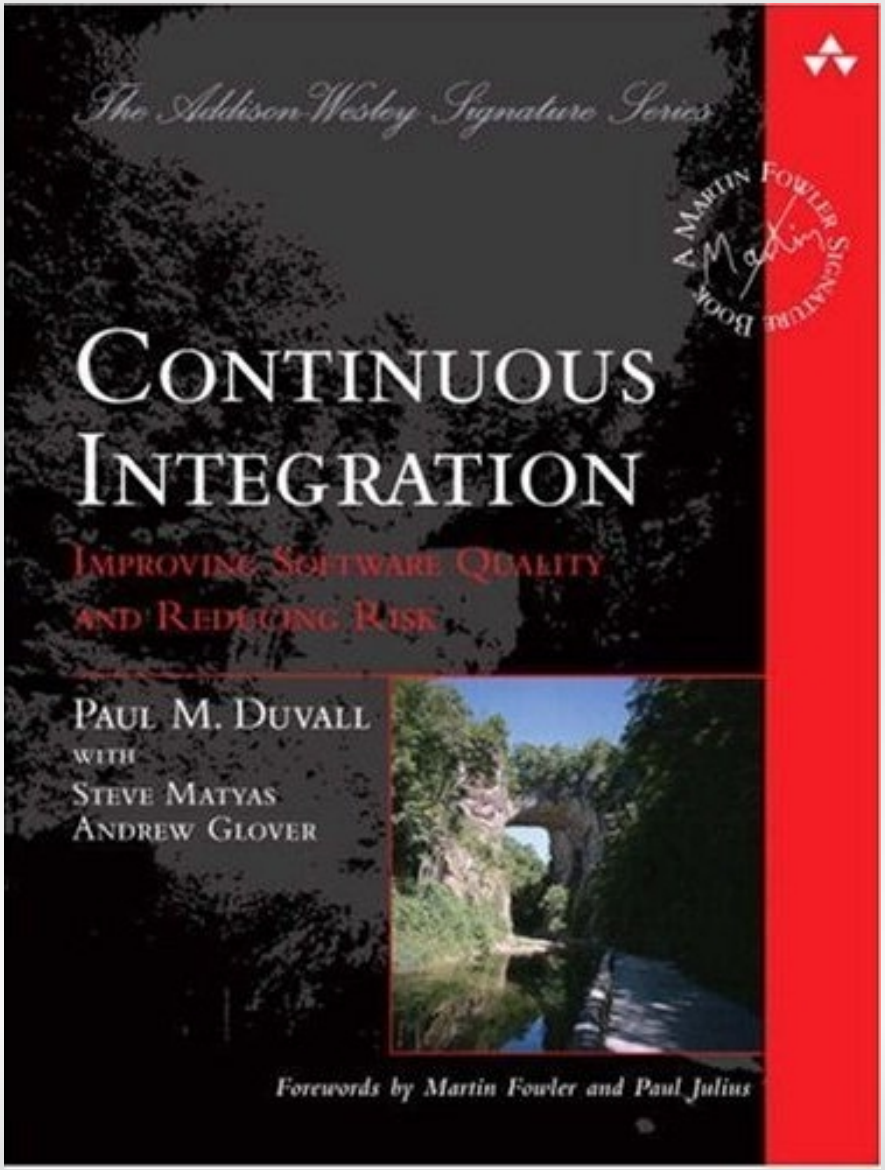
Continuous Integration

Continuous Integration

Paul M. Duvall

Addison-Wesley, 2007

ISBN 978-0321336385



Continous Integration

Software

- CruiseControl
  - phpUnderControl
- Bamboo
- Hudson
- Xinc
- ...

CruiseControl

CruiseControl is a framework for a continuous build process

- It includes, but is not limited to, plugins for email notification, Ant, and various source control tools
- A web interface is provided to view the details of the current and previous builds

CruiseControl

phpUnderControl

phpUnderControl is customization of CruiseControl that caters to the needs of PHP projects

- PHPUnit
- PHPDocumentor
- PHP_CodeSniffer
- (PHP_Depend)
- (PHP_CompatInfo)
- ...

The End

- Thank you for your interest!
- These slides will be available shortly on http://sebastian-bergmann.de/talks/.

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