M0.1 - Testing Refreshment

Guillermo Polito

ECI’23 - Universidad de Buenos Aires

Goals

- Basics of automated testing
- Testing frameworks - test cases
- Fixture, stimuli, checks

- Right BICEP principle

Automated Tests

```
SetTest >> testAdd

  | aSet |
  "Context"
  aSet := Set new.

  “Stimuli"
  aSet add: 5.
  aSet add: 5.

  "Check"
  self assert: aSet size equals: 1.
```

Automated Tests - Context

```
SetTest >> testAdd

  | aSet |
  "Context"
  aSet := Set new.

  “Stimuli"
  aSet add: 5.
  aSet add: 5.

  "Check"
  self assert: aSet size equals: 1.
```

in *this context*

Automated Tests - Stimuli

```
SetTest >> testAdd

  | aSet |
  "Context"
  aSet := Set new.

  “Stimuli"
  aSet add: 5.
  aSet add: 5.

  "Check"
  self assert: aSet size equals: 1.
```

in *this context*
  when *this happens*

Automated Tests - Assertions

SetTest >> testAdd

```
| aSet |
"Context"
aSet := Set new.

“Stimuli"
aSet add: 5.
aSet add: 5.

"Check"
self assert: aSet size equals: 1.
```

in *this context*
when *this happens*
then *this should happen*

Why testing?

Why testing?

- **Increase quality!**

- **Detect regressions**: *Wait, this was working before!*
- **Trust changes**: *I'll refactor/change this piece of critical code…*

- ***Murphy's law:*** *Anything that can go wrong will go wrong*

Kinds of testing

- **Unit tests:** low level, single-component
- **Integration testing:** how different modules work together
- **Functional testing:** focus on the business requirements of an application
- **Acceptance testing:** verify minimal business requirements
- **Performance testing:** behaviors the system under significant load
- **Smoke testing:** check that the system *does not fail*

What is a good test?

What is a good test?

“A good test is a test that catches bugs”

- me

Tests that catch bugs

- check extreme cases (e.g. null, 0, empty, bigger than the collection…)
- check complex cases (e.g. exceptions)
- check different execution paths

Rule of Thumb: the RIGHT BICEP principle

- **Right** - Check if the results are right

- **B** - Check boundary cases
- **I** - Check Inverse conditions
- **C** - Cross-check results with other sources
- **E** - Check error conditions
- **P** - Check performance

Set Example - Right

```
SetTest >> testAdd

  | aSet |
  "Context"
  aSet := Set new.

  “Stimuli"
  aSet add: 5.
  aSet add: 5.

  "Check"
  self assert: aSet size equals: 1.
```

- Elements are added
- Duplicated elements are ignored
- Iteration yields all elements

Set Example - Boundary

SetTest >> testDoEmpty

```
| aSet |
"Context"
aSet := Set new.
c := 0.

“Stimuli"
aSet do: [:e | c := c + 1 ].

"Check"
self assert: c equals: 0.
```

- Set starts empty
- Iteration works on empty collection
- Upper bounds?
  - Sets in Pharo are bound by the memory…

Set Example - Inverse Relationships

SetTest >> testRemoveTwice

```
| aSet |
"Context"
aSet := Set new.
aSet add: 5.
aSet add: 5.

“Stimuli"
aSet remove: 5.

"Check"
self
  should: [ aSet remove: 5 ]
  raise: NotFound
```

- Add two times an element, remove it twice

Set Example - Cross check

```
SetTest >> testCrossSet

  | aSet aTreeSet |
  "Context"
  aSet := Set new.
  aTreeSet := TreeSet new.

  “Stimuli"
  aSet add: 5; add: 5.
  aTreeSet add: 5; add: 5.

  "Check"
  self
    assert: aSet size
    equals: aTreeSet size
```

- Compare different set implementations

Set Example - Error conditions

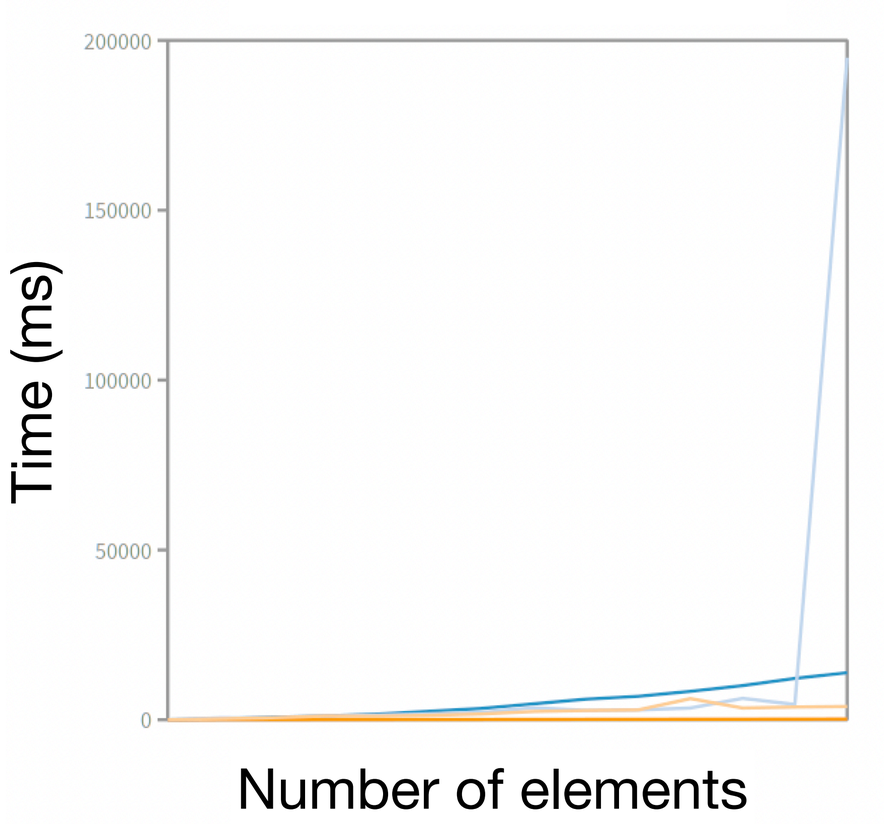
```
SetTest >> testAnyEmptySet

  | aSet aTreeSet |
  "Context"
  aSet := Set new.
  aTreeSet := TreeSet new.

  "Check"
 self
   should: [ aSet anyOne ]
   raise: CollectionIsEmpty
```

- Accessing elements in an empty set
- Remove an element that never was there

Set Example - Performance



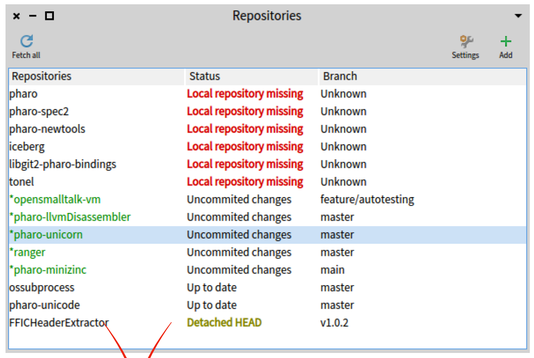
- Scalability to many elements
  - adding
  - removing
- Assert => set performance expectations

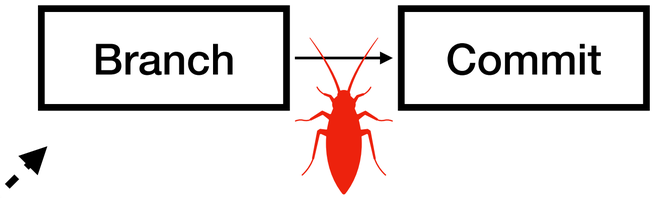
Challenging tests

- Examples
  - non-deterministic behavior
  - user-interactions
  - external interactions

- **non-deterministic => deterministic**
  - Mocks
  - Control random seeds
  - Simulations

Case Study: Git Client



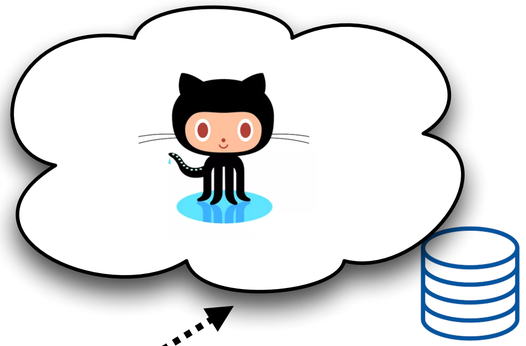


LibGit

Git Client

Git Repository

Remote repositories



Working Copy

Index

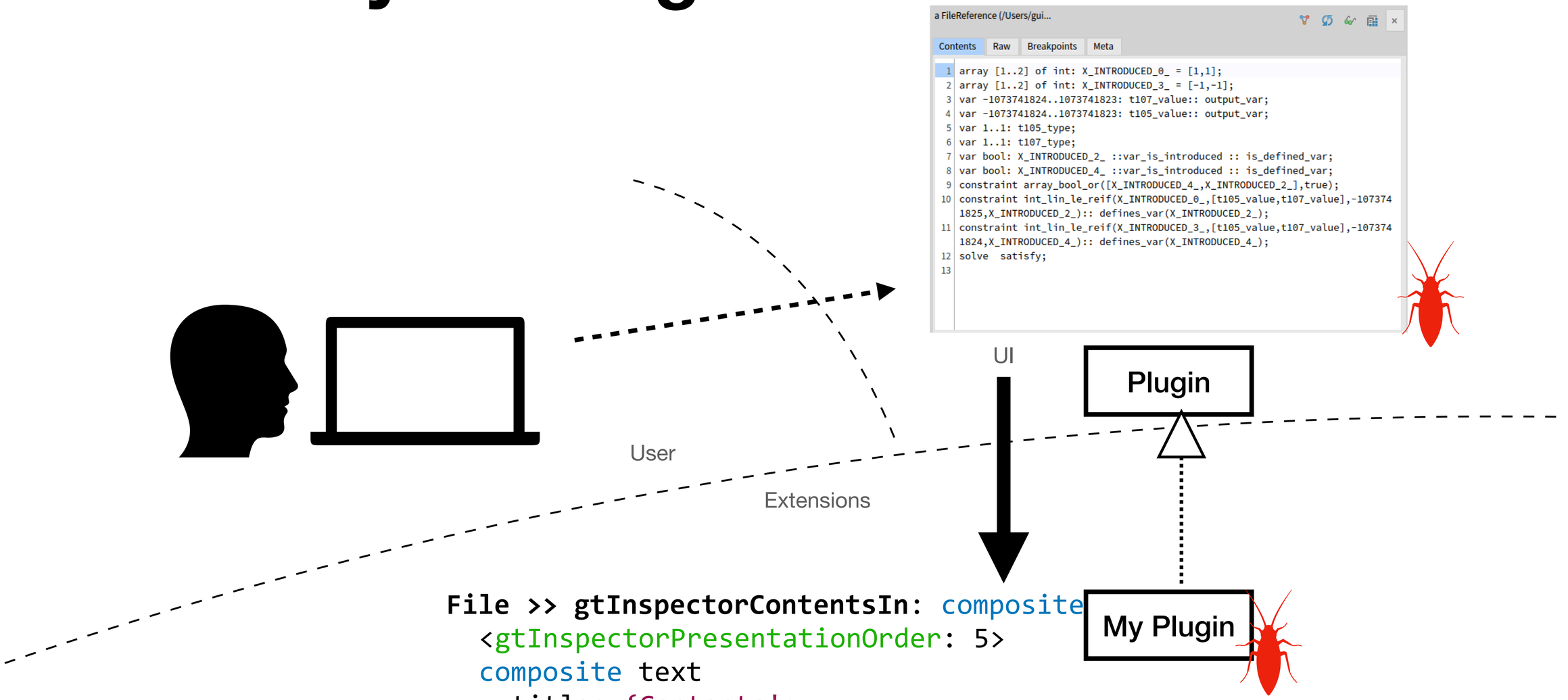
Repository

What you see

A “hidden” staging area (sort of)

Where **commits** are

Case Study: UI Plugins




```
File >> gtInspectorContentsIn: composite
  <gtInspectorPresentationOrder: 5>
  composite text
    title: 'Contents';
    format: #asText;
    display: [ … ]
```

Takeaways

- Test automation helps scaling the testing activities
- Simple heuristics such as Right BICEP can guide effective test writing

- Some tests can still be challenging to write
  - Look for smart and simple solutions
  - E.g., Mocking, simulations

Material

- Learning Pharo: [Mooc](https://mooc.pharo.org/)
  - Week 1 Lecture 4: 🐥 Pharo Object Model in a Nutshell
  - Week 1 Lecture 5: 🐥Lecture Pharo Syntax in a Nutshell
  - Week 1 Lecture 6: 🐥Lecture Class and Method Definitions
- Introduction to SUnit unit testing
  - Pharo by example book: https://books.pharo.org/updated-pharo-by-example/
  - [Mooc](https://mooc.pharo.org/) Week 5 lecture 6: 🐥 SUnit: Unit Tests in Pharo
- Fuzzing Book, introduction to software testing: https://www.fuzzingbook.org/html/Intro_Testing.html