The Test Case as Executable Example

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Study of

the human activity of comprehending software;
the processes and technologies for supporting it
Programming by Example

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University of California, Berkeley
November, 1984
Sponsor: Xerox Corporation
Susan L. Graham, Committee Chair

Abstract: Programming by example is a way of programming a software system in its own user interface. The user of the system writes a program by giving an example of what the program should do. The system records the sequence of actions, and can perform it again. Programming by example allows a user to create programs without doing conventional programming.

Programming by example was incorporated into a simulation of an office information system. As the system evolved, it became clear that the basic concept of programming by example needed to be extended: certain aspects of program creation are better done by program modification than by using the

Spreadsheet Data Manipulation Using Examples

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ABSTRACT

Millions of computer end-users need to perform tasks over large-spreadsheet data, yet lack the programming knowledge to do such tasks automatically. We present a programming-by-example methodology that allows end-users to automate such repetitive tasks. Our methodology involves designing a domain-specific language and developing a synthesis algorithm that can learn programs in that language from user-provided examples. We present instantiations of this methodology for particular domains of tasks: (a) syntactic transformations of strings using restricted forms of regular expressions, conditionals and loops, and (b) semantic transformations of mailing lists using generic manipulation of mailing lists.

Input $v_1$

Output

323-708-7700
425-706-7709
510-220-5586
235-7654
745-8139

323-708-7700
425-706-7709
510-220-5586
425-235-7654
425-745-8139

1. In this task, users wish to 

2. OVERVIEW

In this section, we outline a general methodology that we have used for developing interactive synthesizers for end-user programming tasks, along with how a user can interact with the synthesizers. In the first part of our methodology, we identify a domain of useful tasks that end-users struggle

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*Work done during an internship at Microsoft Research.

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The Testing Perspective

- A test case is an executable example of system behavior

- Stakeholder communication needs examples

- Throughout the full development cycle
Feature: Log in and out

As an administrator
I want to restrict access to certain portions of my site
In order to prevent users from changing the content

Scenario: Logging in
Given I am not logged in as an administrator
When I go to the administrative page
And I fill in the fields
  | Username | admin |
  | Password | secret |
And I press "Log in"
Then I should be on the administrative page
And I should see "Log out"

Scenario: Logging out...
Plugin / Junit Testing in Eclipse.
1000s of tests
## Test Suite Information Needs

<table>
<thead>
<tr>
<th>ID</th>
<th>Need</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>Understanding test (source) code</td>
<td>$P_{11,17,18}$</td>
</tr>
<tr>
<td>N2</td>
<td>Understanding the reason (requirements) for a test</td>
<td>$P_{3,7,11,12,19}$</td>
</tr>
<tr>
<td>N3</td>
<td>Identifying what is tested by a test, test plug-in and (assembled) test suites</td>
<td>$P_{8,11,12,14}$</td>
</tr>
<tr>
<td>N4</td>
<td>Identifying blank spots</td>
<td>$P_{3,7,10,14}$</td>
</tr>
<tr>
<td>N5</td>
<td>Getting an overview of test suites</td>
<td>$P_{7,10,14}$</td>
</tr>
<tr>
<td>N6</td>
<td>Understanding integration with other plug-ins</td>
<td>$P_{7,10}$</td>
</tr>
<tr>
<td>N7</td>
<td>Understanding test organization</td>
<td>$P_{8,10,12,13,18,19}$</td>
</tr>
<tr>
<td>N8</td>
<td>Locating test code</td>
<td>$P_{13,19}$</td>
</tr>
<tr>
<td>N9</td>
<td>Identifying what influences the test execution environment</td>
<td>$P_{6,8}$</td>
</tr>
</tbody>
</table>

**Test Confessions: A Study of Testing Practices for Plug-In Systems**  
Michaela Greiler, Arie van Deursen, Margaret-Anne Storey, ICSE 2012
Challenges

- Set of examples is **incomplete**
- Set of examples is **too large**
  - Some grouping needed
  - Redundancy
- Set of examples is **disconnected**
  - Requirements traceability
  - Backward coverage

Test Similarity
End-to-End Test

Requirements Analysis

High Level Design

Integration Test

Code

Unit Test

Measuring Test Case Similarity to Support Test Suite Understanding

Michaela Greiler, Arie van Deursen, Andy Zaidman, TOOLS 2012
Measuring Test Case Similarity

Test-aware instrumentation

Test Traces

Shared word count

Tests ranked by similarity
Preliminary Evaluation

- 75 unit tests
- 14 acceptance tests
- Ground truth by hand

- 37 unit
- 6 end to end
- Ground truth from book

- Most similar match: #1 or #2 in ground truth
- Top 10: all (but one) explainable & useful
- Surprises: mostly point to issue in test suite.

- Work in progress:
  Analyzing Eclipse test suites.
Rethinking “Test Cases as Examples”

• Languages for writing examples
  – Different levels of abstraction / stakeholders
  – Executable
  – Analyzable
  – *Connected to execution traces*

• Modularization and grouping of examples
  – Different levels of abstraction / stakeholders
  – Requirements / design / code coverage
  – Multiple views
  – *Connected via execution traces*
In Conclusion

• A test case is an executable example
• Never enough, yet also too many

• Test case connection via trace similarities
• Language engineering opportunities ahead
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