Finding Bugs by Isolating Unit Tests

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Independence Assumption

• Unit tests are assumed to be independent
  – Test frameworks (e.g., JUnit)
  – Test selection and test prioritization

“For the most part we just assumed that test cases would be independent, but we didn’t think to make that explicit.”

Michal Young
Author of Software Testing and Analysis: Process, Principles, and Techniques
## Example (Apache Commons CLI)

```java
public class OptB {
    private static String name;

    public static Option create() {
        Option result = new Option();
        clear(); return result;
    }

    public static Option createWithArg() {
        Option result = new Option(name);
        clear(); return result;
    }

    private static void clear() {
        name = "arg";
    }
}
```

**Code**

```
public void testOption() {
    Option opt = OptB.create();
    // Test some property of opt.
}
```

```
public void testOptionWithArg() {
    Option opt = OptB.createWithArg();
    assertEquals(opt.getName(), "arg")
}
```

*OptB = OptionBuilder*
Example (Apache Commons CLI)

```java
public class OptB {
    private static String name;

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    public void testOptionWithArg() {
        Option opt = OptB.createWithArg();
        assertEquals(opt.getName(), "arg")
    }
}
```

*OptB = OptionBuilder

Test

Test

Test

Test

null
public class OptB {
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}
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        // Test some property of opt.
    }

    public void testOptionWithArg() {
        Option opt = OptB.createWithArg();
        assertEquals(opt.getName(), "arg")
    }
}
```

```
*OptB = OptionBuilder
```

```
null
```

```
Option
```

```
Option
name: "arg"
```

```
Test
```

```
Test
```

```
1
```

```
2
```
Example (Apache Commons CLI)

code

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    public static Option create() {
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*OptB = OptionBuilder

Test

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}
```

public void testOption() {
    Option opt = OptB.create();
    // Test some property of opt.
}

public void testOptionWithArg() {
    Option opt = OptB.createWithArg();
    assertEquals(opt.getName(), "arg")
}

OptB name: null
Option name: null
*OptB = OptionBuilder
Test Isolation

TestSuite
- testOption()
- testOptionWithArg()
- test3()

JUnit
- testOption()
- testOptionWithArg()
- test3()

JUnit
- testOption()
Test Isolation

TestSuite
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- testOptionWithArg()
- test3()

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Preliminary Results

153 Revisions

Test Isolator

commons CLI

3 Failing Tests

test27635  test13666
testOptionWithout ShortFormat2
Preliminary Results

OptionBuilder.java

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2004

Reported to the bug database by a user.
Preliminary Results

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OptionBuilder.java
2004 Reported to the bug database by a user.
2007 Marked as resolved.

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OptionBuilder.java

2004

Reported to the bug database by a user.

2007

Marked as resolved.

2009

Reopened by another user submission.

2010

Fixed.
Preliminary Results

Test Isolator

153 Revisions
commons CLI

3 Failing Tests
- test27635
- test13666
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120 Revisions
3 Changes to OptionBuilder.java

OptionBuilder.java

- Reported to the bug database by a user.
- Marked as resolved.
- Reopened by another user submission.
- Fixed.
Related Work

• Independence between unit tests is widely assumed
• Problem is noted by other work on testing [Robinson2011]
Future Work

• Analyzing more OSS projects
• Characterizing data dependency types
• Pinpointing the location of the dependency
• Extending the existing testing frameworks to support running tests in isolation
Contributions

• Counterexample to the independence assumption
  – Real system
  – Real cost
  – Easy to confirm

• Adds incentive to testing R&D to reconsider independence assumption