Adaptating Amplified Unit Tests for Human Comprehension

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Thursday 8th March, 2018 @ KTH

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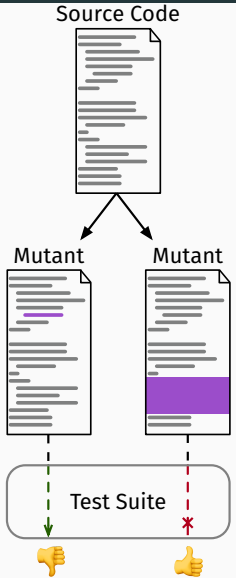
Mutation Testing

Evaluating the quality of a test suite by injecting bugs



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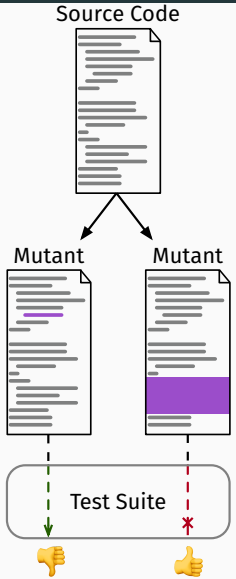
Examples of *mutators*:

- change a > condition with <;
- delete the body of a method.



Mutation Testing

Evaluating the quality of a test suite by injecting bugs

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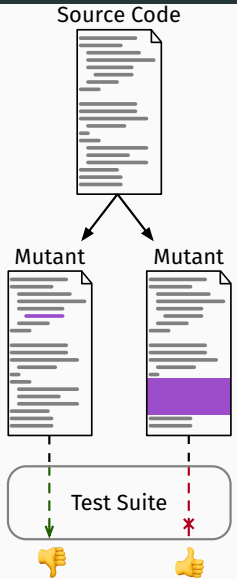
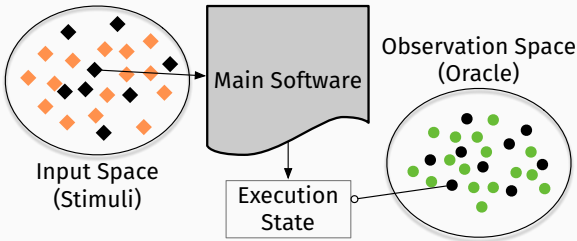
Goal

Enhance test suite by detecting new mutants



DSpot[1]

Randomly modifies test cases:



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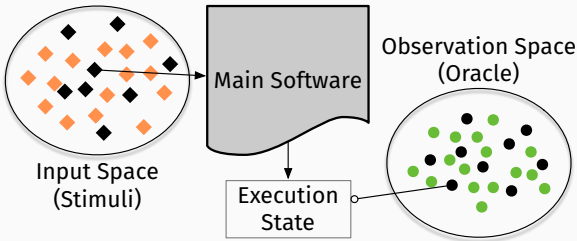

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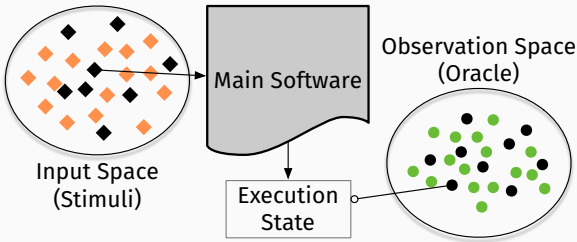

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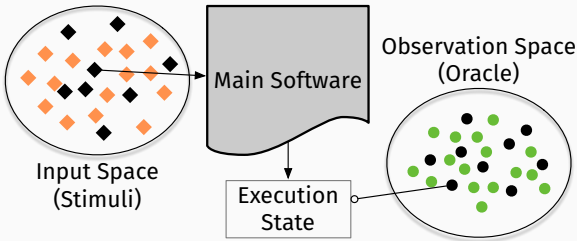

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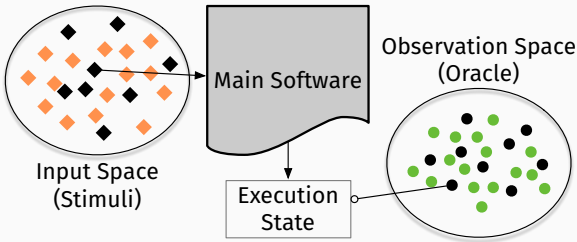

Benjamin Danglot, INRIA Lille, France

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Example[2]

```java
@Test
public void immutableGraph() {
  MutableGraph<String> mutableGraph = GraphBuilder.directed().build();
  mutableGraph.addNode("A");
  ImmutableGraph<String> immutableGraph = ImmutableGraph.copyOf(mutableGraph);

  assertThat(immutableGraph).isNotInstanceOf(MutableValueGraph.class);
  assertThat(immutableGraph).isEqualTo(mutableGraph);

  mutableGraph.addNode("B");
  assertThat(immutableGraph).isNotEqualTo(mutableGraph);
}
```

[2] https://github.com/google/guava/blob/master/guava-tests/test/com/google/common/graph/ImmutableGraphTest.java#L29-L40

Example of Amplification

```java
@Test
public void immutableGraph() {
  MutableGraph<String> mutableGraph = GraphBuilder.directed().build();
  mutableGraph.addNode("A");
  mutableGraph.addNode("C");
  ImmutableGraph<String> immutableGraph = ImmutableGraph.copyOf(mutableGraph);

  assertThat(immutableGraph).isNotInstanceOf(MutableValueGraph.class);
  assertTrue(immutableGraph.nodes().contains("A"));
  assertThat(immutableGraph).isEqualTo(mutableGraph);

  mutableGraph.addNode("B");
  assertThat(immutableGraph).isNotEqualTo(mutableGraph);
}
```

Goal

→ Human-friendly, high-level, natural language description

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First objective: an explanation per mutant kill.

Identify Relevant Statements

Identify the killing assertion.

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Simple static slicing:

- starting from the killing assertion;
- control-flow slicing and
- data-flow slicing.

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Java slicing tool

T.J. Watson Libraries for Analysis (WALA)[3]

Established library with active development.

[3] https://github.com/wala/WALA

Cleaning the Amplifications

Minimisation phase → less explanation to generate.

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Minimizing only amplifications

- Less time consuming.
- Keep the original part intact → better for understanding.

UnitTestScribe[4][5]

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🎉 Empirical study and survey → need for automated documentation.

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Code changes summarisation (i.e. commit message generation)

Focused on general source code (add feature, fix bug, ...).

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Related Works Limit

Problem

No “why” information. Paraphrasing the code.

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Reason for amplifications to exist → mutant kill.

Natural Description

Better oracle:

- what part of the system was left out;
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New kind of behaviour:

- differences in traces to explain how a bug is triggered;
- use mutators stereotypes to explain how the inputs are modified.

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- Study repos with strong commit message guidelines (e.g. Google).

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- Performances.
- Survey with real developers.