Automatically Finding Bug Locations

Program Spectra Visualization and Analysis for Fault Localization

Abstract

Spectrum-Based Fault Localization (SBFL) uses the information derived during testing to identify the faults existing in the subject program. However, because of the diversity of real-life programs and faults, current SBFL techniques cannot adapt all the debugging situations. Without knowing how SBFL works, we cannot get sufficient confidence to use it in practice. In our work, we propose a framework that illustrates the spectra distributions of various debugging instances and the performance of SBFL at these instances in a graphical way. Based on visualization, we can get a better analysis and understanding of the rationales of various instances in which SBFL is applied.

SBFL and Metrics

\[ PG : \text{the subject program; } s \in S \text{ statements; } s' : \text{faulty statements; } t \in T : \text{test cases; } s \in C : \text{statements covered by } t; \alpha \in \{ \text{pass, fail} \} : \text{the correctness of } t \]

Subject Program

Test Info.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Test Info.</th>
<th>Components' Spectra</th>
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Basic Intuitions

Basic Intuition 1: Statements covered by more failure-revealing test cases are more likely to be faulty. Basic Intuition 2: Statements covered by more passed test cases are less likely to be faulty.

SBFL Metric Comparison (PRDC'19)

Research Contents

Software Testing

1. Fault localization: where is the fault?
2. Understanding: why is it a fault?
3. Repairing: how to remove the fault?

Automated Fault Localization

Is there a fault?

Software Debugging

How to correct the fault?

Debugging

Propagation Analysis (EASE'20)

Spectra of CPS Components

Visualization Framework

The graphical characteristics of 1) the distribution of image points, 2) the shape of Metric Performance Curves. Analyzing the performances and rationales of various SBFL techniques.

SBFL Metric Comparison (PRDC'19)

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