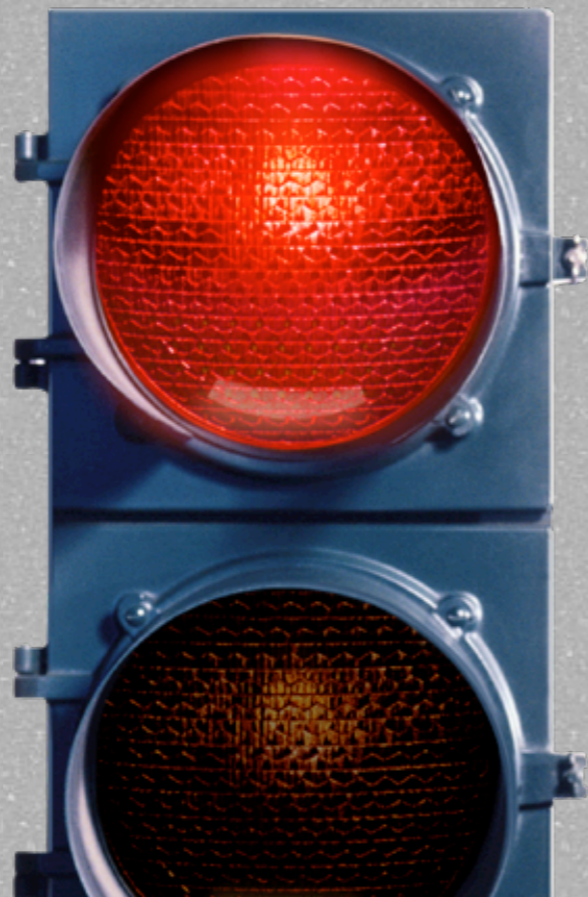# Locating Defects is Uncertain

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Why Programs Fail

A Guide to Systematic Debugging

Andreas Zeller

- A 400-page book on systematic debugging

- Appears September 2005 (Morgan Kaufmann)

www.whyprogramsfail.com

What is a bug?

- A *bug* is a defect.

- A *defect* is an error in the code.

- An *error* is a deviation of what's correct, right, or true

▸ A *defect is a deviation from the correct code*

What is a defect?

- How do we know the correct code?

- We don't know (until we *fixed* the code)

▸ *A defect is the code which was fixed*

▸ *Defect detection is about suggesting fixes*

Do we have a defect?

- Or: Is this bug real?

- Or: Do we have to change something?

▸ Evaluation: *Did people change something?*

Where is the defect?

- Or: Where do we have to change something?

▸ Evaluation: *Where did people change something to fix the defect?*

Locating Defects

- The defect is in some entity E iff E fails

- Easy to tell for programs (test fails)

- Harder to tell for functions (postcond fails)

- Almost impossible to tell for statements

▸ *Becomes harder with finer granularity*

Predicting Changes

- Ultimate evaluation: Can we predict the fix?
  - ▸ *We can only provide educated guesses*
- How close are we to the actual fix?
  - ▸ *We must learn from actual fixes*

Program Analysis

Code   Specs   Runs

Tests   Classes   Field

History   Bugs   more…