Measuring the Gain of Automatic Debug

Daniel Hansson
CEO
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Agenda

• Definition of Automatic Debug
• Tools and Methodologies
• How we measured the gain of Automatic Debug
• Random Tests
• Results
Definition: Regression Failure

- Something that used to work, but has stopped working.
- The failure is caught by test failures, which needs manual debug.
- A lot of engineering hours and project time is spent on regression failures

Test: rx_test_45
Build: build_23
Error: Failure: Expected RX data 0x4545, but got 0x5555

Test: rx_test_51
Build: build_13
Error: Failure: Expected RX data 0x4545, but got 0x5555

Test: rx_test_54,
Build: build_13
Error: Failure: No data
Definition: Automatic Debug of Regression Failures

- Automatically finding the bad commit in the revision control
- Directly assign and report the bug to the responsible committer
- No engineering hours spent, except for bug fixing
- Active 24/7 – bugs are pushed back faster

Bug No: 1 (new bug)  
Test: rx_test_45 (in total 3 failures)  
Build: build_23  
Error: Failure: Expected RX data 0x4545, but got 0x5555  
Committer: dhansson  
Commit Message:  
268243. Changed default value of rx_mode_reg  
Committed Files:  
//dwar/Hardware/ASICproject/main/dev/productFast/hardware/rx_main.v#4
Tools And Methodologies

Pre-Integration:
- Test each change before commit
- Short smoke tests
- Random tests not supported
- Tools: Jenkins, CruiseControl, BuildBot

Post-Integration:
- Debug failures post-integration
- Large test suites supported
- Random tests supported
- Tools: PinDown
PinDown™

- PinDown Results Database
- PinDown TestHub
- Test Executor (LSF Farm)

Version Control System

Start Job
Starting point: 200 tests run, 10 failed.
Each test takes 1 hour. Max allowed debug jobs on the farm: 10.
Select the pilot test, i.e. the fastest test. Test it on 10 revisions in parallel. Found a pass-fail transition (rev 9 and 13), but there may be more transitions,
Automatic Debug

Test another 10 revisions to get high probability in debug analysis.
Found first faulty rev (17). Bug report emailed to committer after 2 hours debug time.
Check if the other failing tests have the same tipping point. Start with the pass. The result: 3 tests don’t. They are due to a second bug.
Automatic Debug

Pick the pilot test for the second bug and run on 10 revisions

Patent Pending
After the second run of the pilot test for bug no 2 we find the tipping point. Bug no 2 emailed to committer after 5 hours.
Checking if all remaining tests match the tipping points of the two reported bugs
They do. Debug run completes after 6 hours.
Random Test Setup

Regression Testing with Random tests cannot separate a regression from new coverage
- Inefficient debugging of regressions
- Unable to separate bad news (regressions) from good news (new coverage)

PinDown solves this:

- Quality Maintained: Issues are fixed fast as the bad revision is known
  - Bug Reports:
    - Bug 1: John broke test t1, seed 33, in rev 33
    - Bug 2: Hemal broke test t2, seed 34, in rev 145
    - Bug 3: Sue broke test t4, seed 11, in rev 11

- New coverage: Good news, increase in coverage
  - No panic, not a quality dip

(John)  (Hemal)
Random stability is depends on the type of testbench change

- PinDown may sometimes not be able to reproduce the issue
  - Less of a problem when frequent testing

- PinDown allows a setup choice: Include/Not include Testbench
Measuring how fast bugs were fixed

- Real commercial ASIC project:
  - Based on random testing
  - We analyzed 39 regression bugs found during 3 months of the project

- PinDown was setup to track the following in the revision control system:

  **Tracked:**
  - Device under test (DUT)
  - Testbench
  - Scripts and tools for build and test

  **Not Tracked:**
  - Some internally developed tools and scripts (they were under revision control, but not tracked by PinDown)

- We measure the time from when the report is emailed out until the fix is committed:

- In both cases PinDown is emailing out the report, but automatic debug is only enabled for the areas that PinDown is setup to track

- No difference in complexity between tracked and non-tracked areas.
  - Complex bugs were fixed by simply removing the commit.
Results: 400% faster bug fixing

(5.7h for automatic debug, 23h for manual debug)

(7.4h for automatic debug, 26.1h for manual debug)

5x less discussions
(0.5 emails automatic debug, 2.6 emails manual debug)
Measuring the Gain of Automatic Debug

Summary

- Automatic Debug speed up bug fixing by 400% in this ASIC project

How was that achieved?

- Precision and clear responsibility
  - The bug report shows who did what and when
  - This in turn lead to 5x less discussion prior to bug fixing

- Automatic Debug is active 24/7
  - Bugs occur late in the day, leaving little time for same-day manual debug