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Measuring the Gain of Automatic Debug

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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: Failuire: Expected RX data 0x4545, but got 0x5555

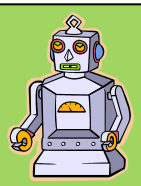
Test: rx_test_51
Build: build_13
Error: Failuire: Expected RX data 0x4545, but got 0x5555

Test: rx_test_54,
Build: build_13
Error: Failuire: No data

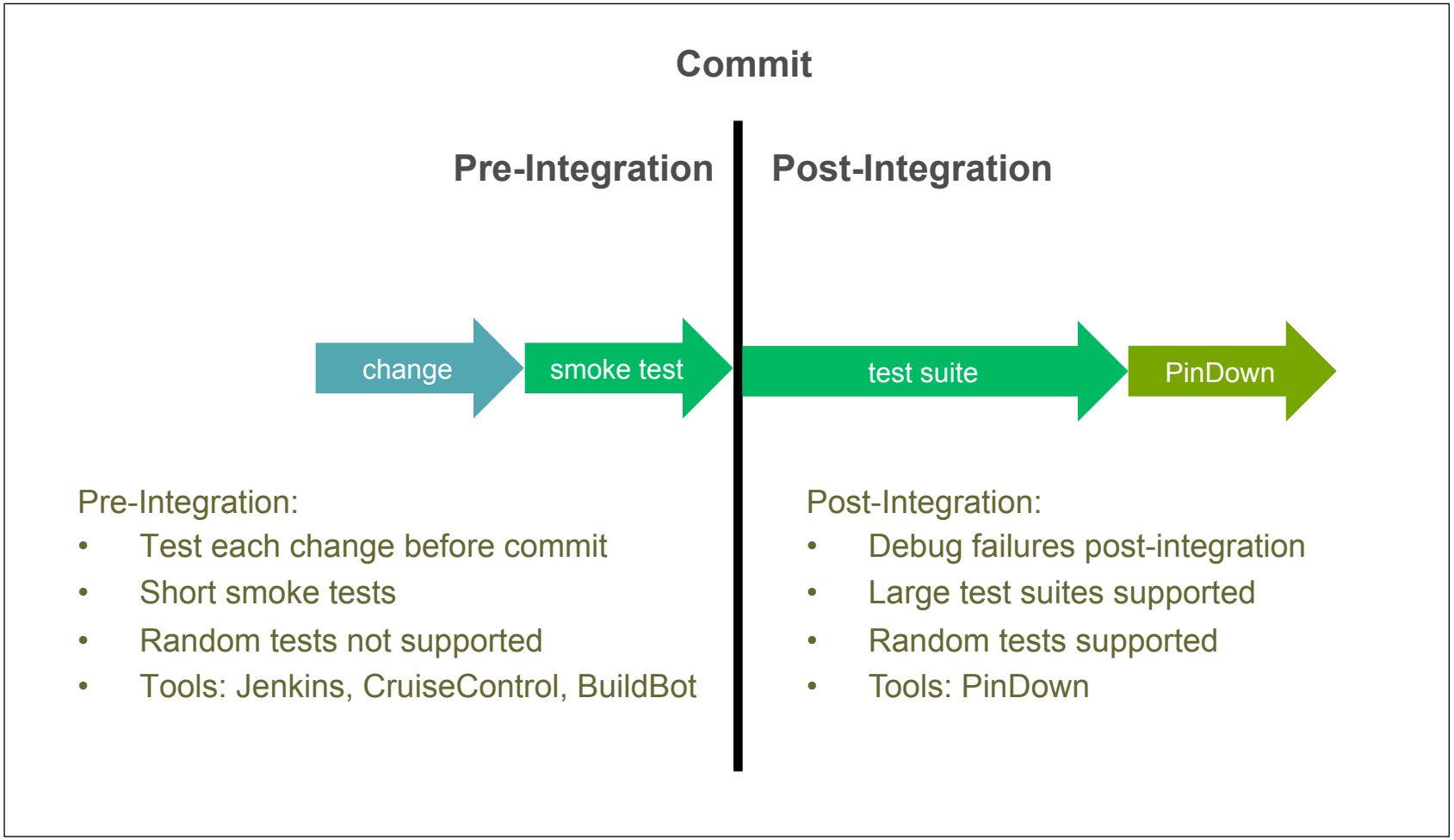
Definition: Automatic Debug of Regression Failures

- 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

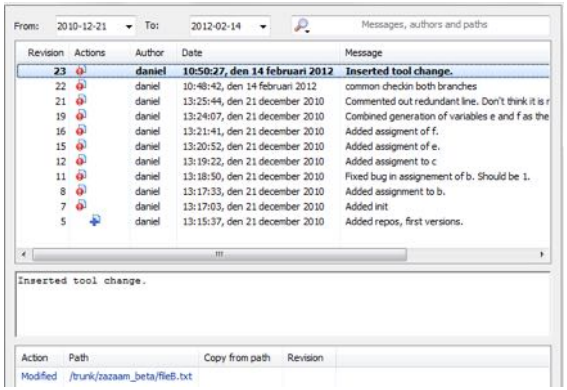
Bug No: 1 (new bug)
Test: rx_test_45 (in total 3 failures)
Build: build_23
Error: Failuire: Expected RX data 0x4545, but got 0x5555
Committer: dhansson
Commit Message:
268243. Changed default value of rx_mode_reg
Committed Files:
//dwarc/Hardware/ASICproject/main/dev/productFast/hardware/rx_main.v#4



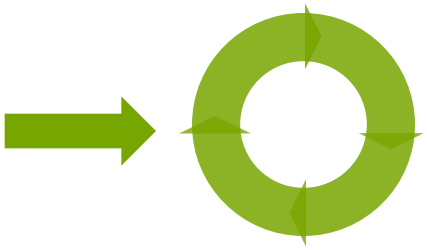
Tools And Methodologies



PinDown™



Version Control System

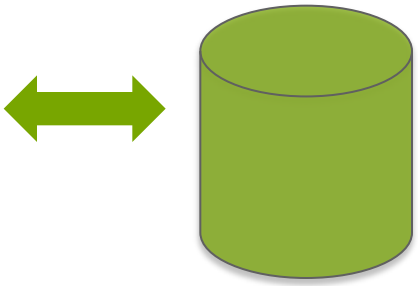


PinDown Job

Test Executor
(LSF Farm)

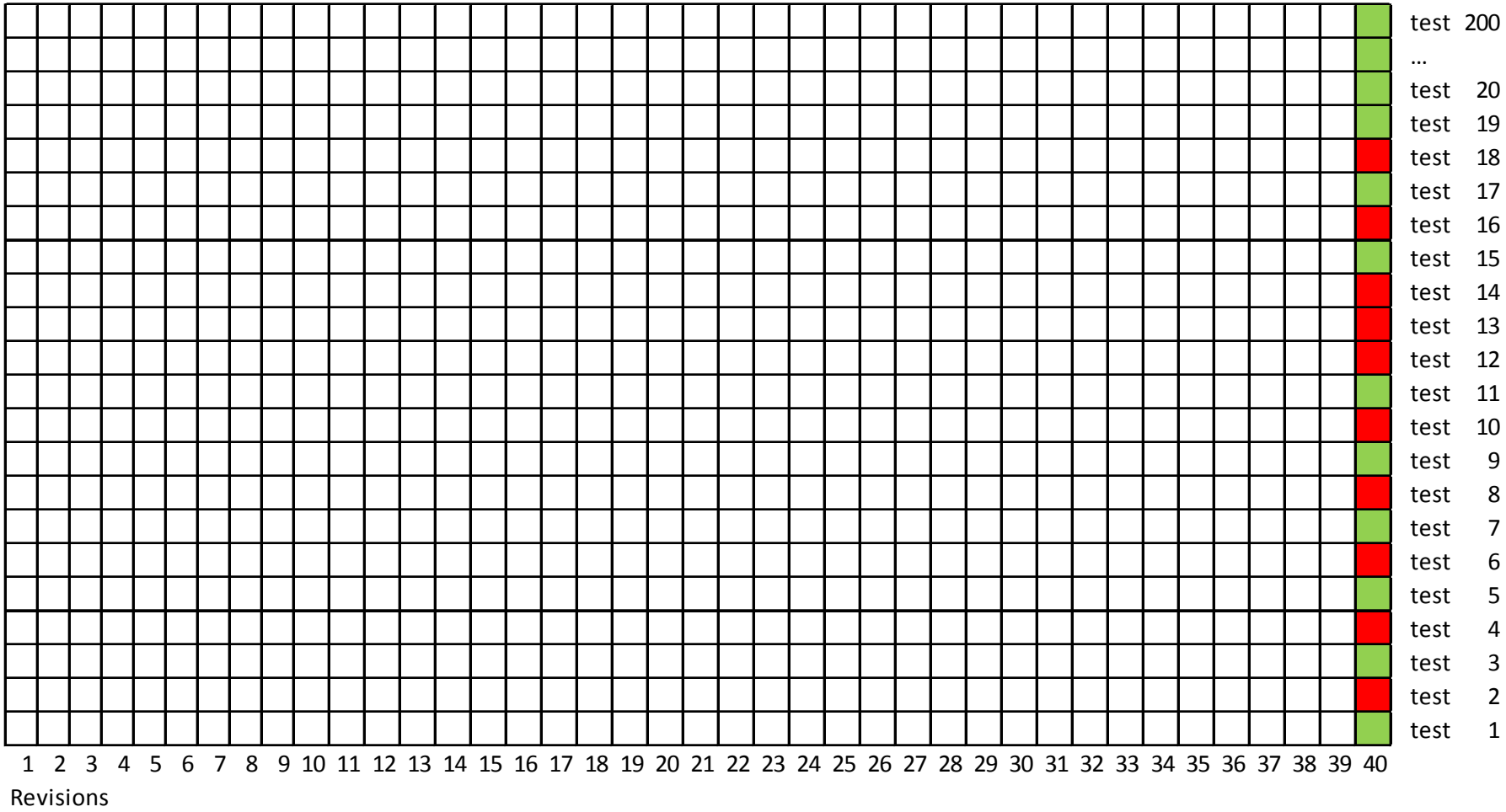
Start Job

PinDown TestHub



PinDown Results Database

Automatic Debug



Starting point: 200 tests run, 10 failed.

Each test takes 1 hour. Max allowed debug jobs on the farm: 10.

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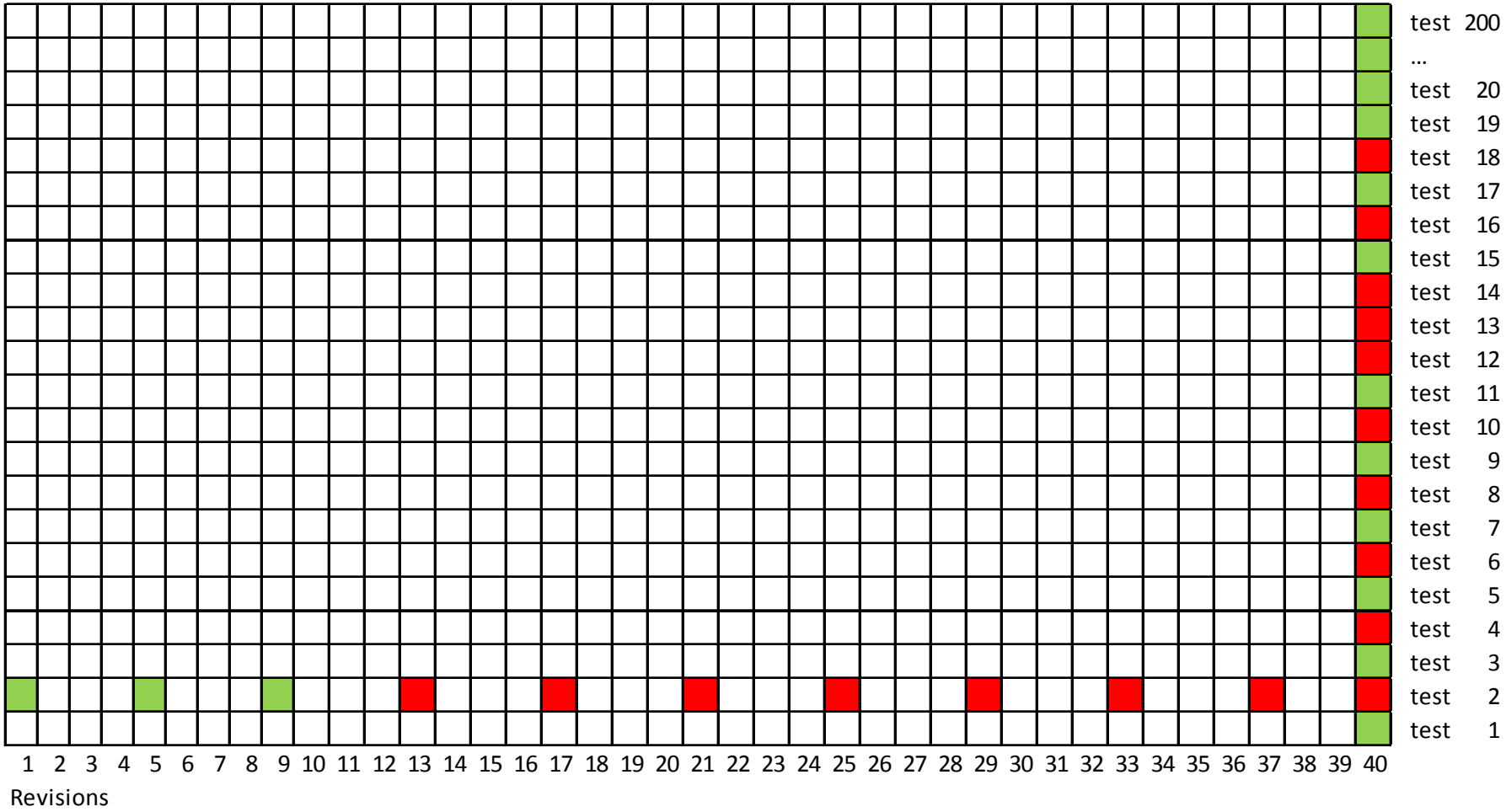

Select the pilot test, i.e. the fastest test. Test it on 10 revisions in parallel.
Found a pass-fail transition (rev 9 and 13), but there may be more transitions,

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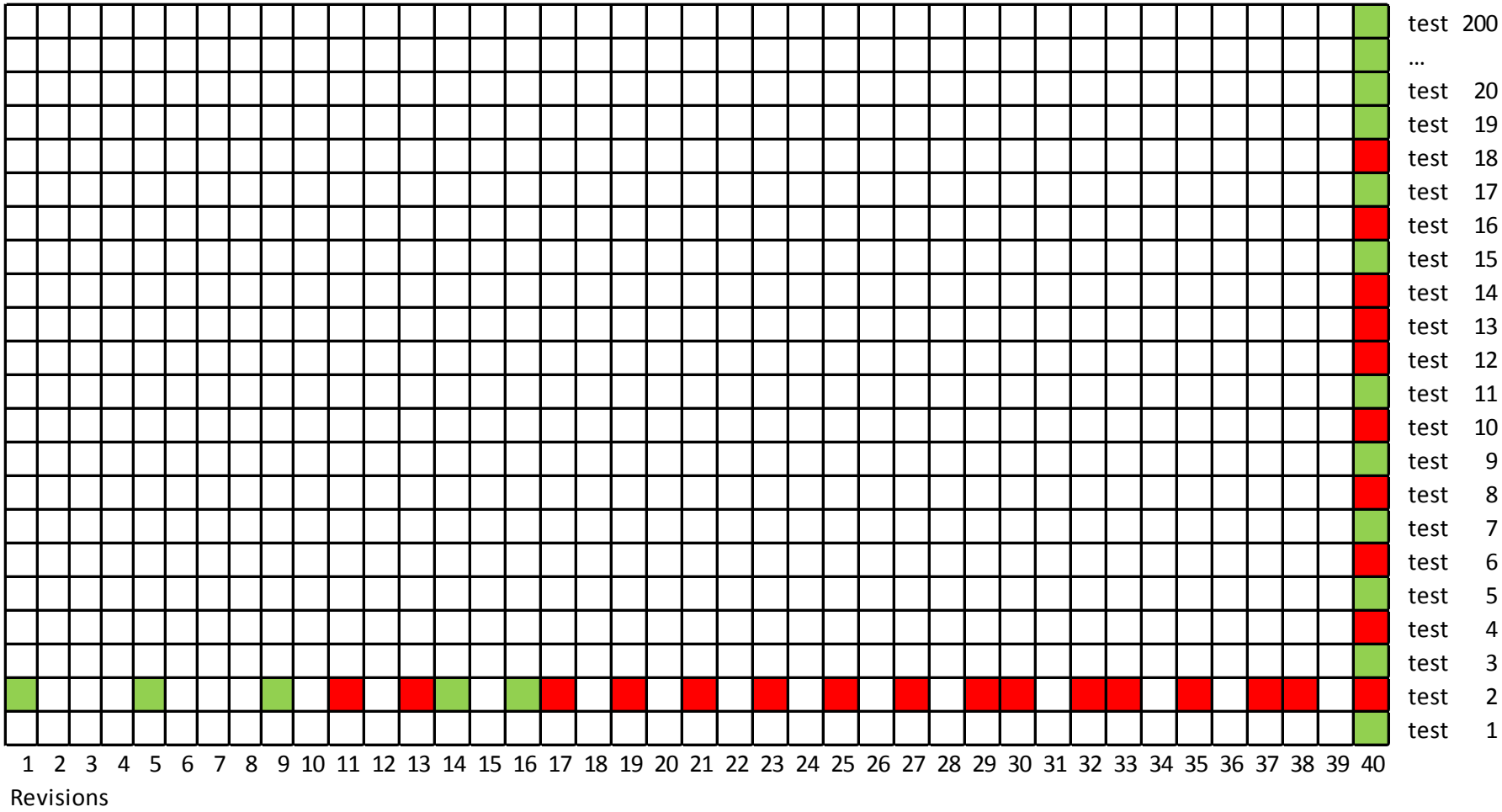

Test another 10 revisions to get high probability in debug analysis.

Found first faulty rev (17). Bug report emailed to committer after 2 hours debug time.

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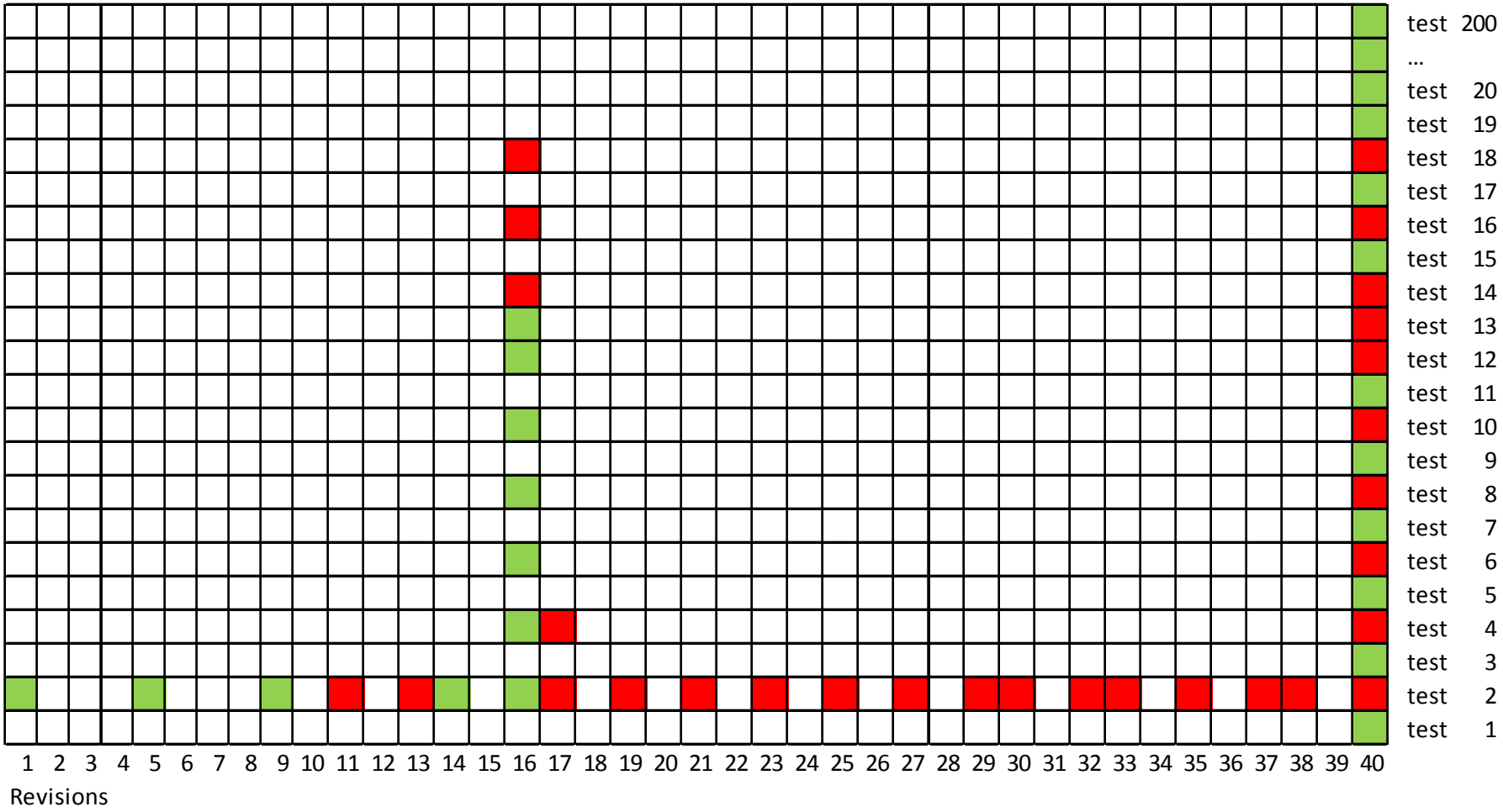
Automatic Debug



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.

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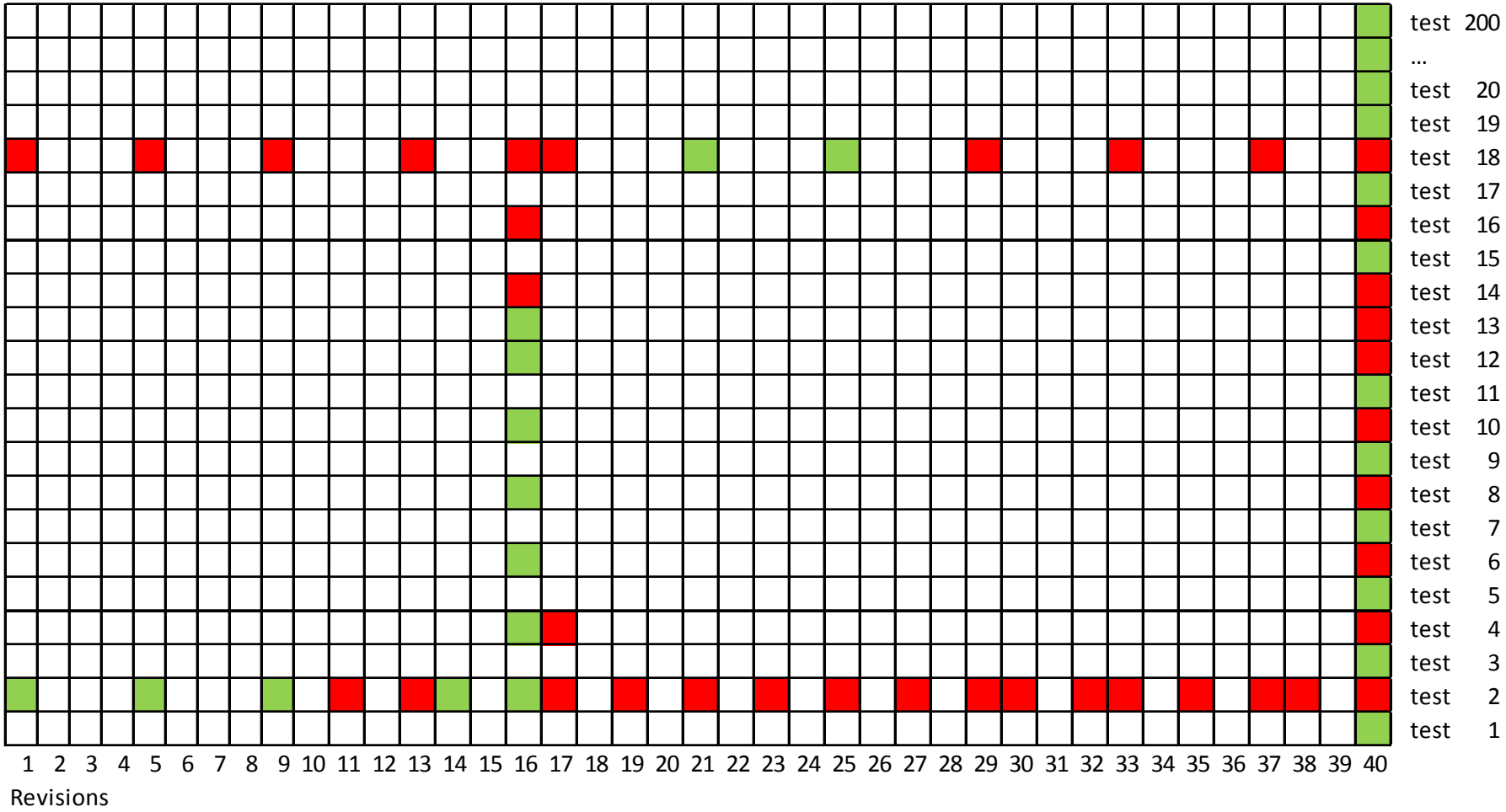

Pick the pilot test for the second bug and run on 10 revisions

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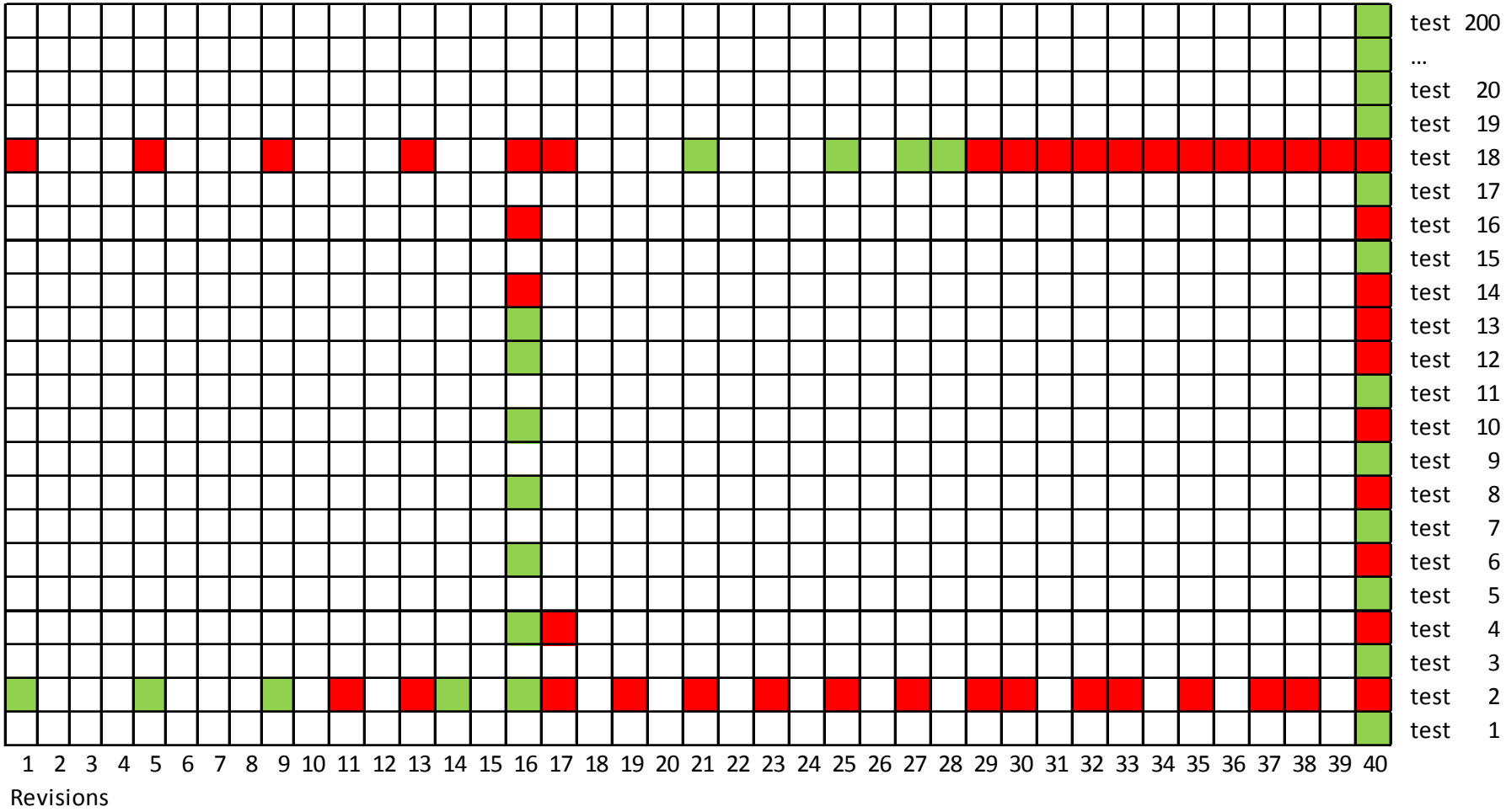
Automatic Debug



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

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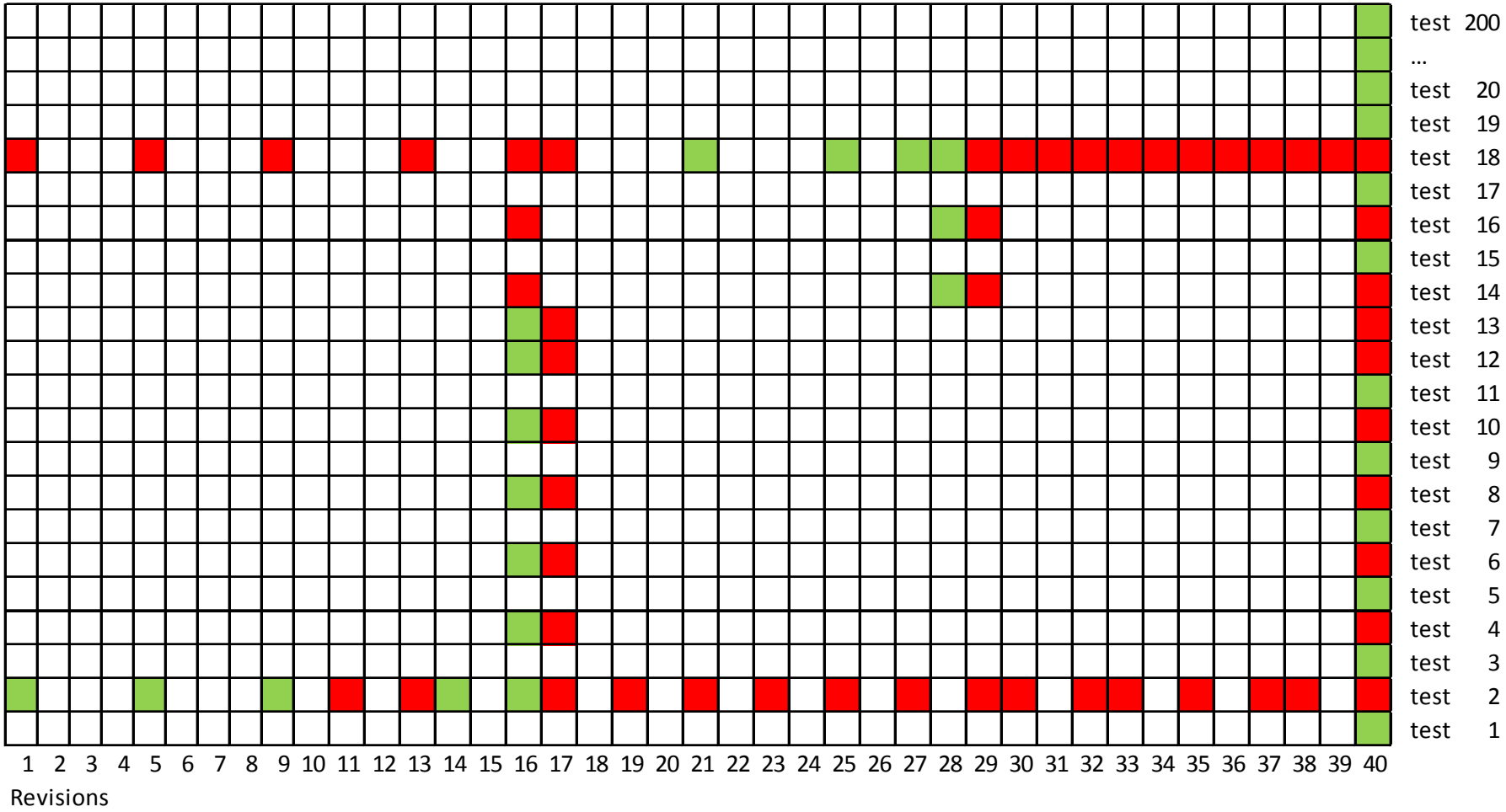

Checking if all remaining tests match the tipping points of the two reported bugs

They do. Debug run completes after 6 hours.

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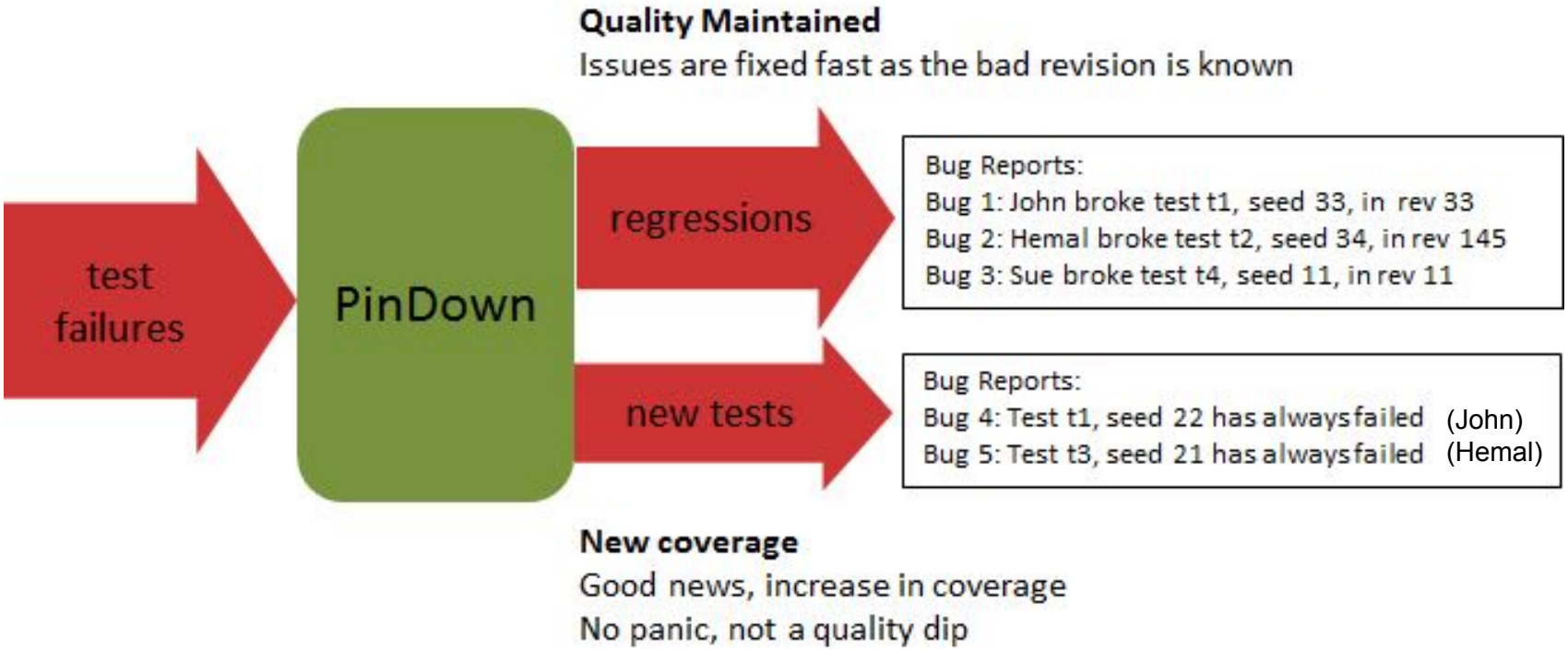
Random Test Setup

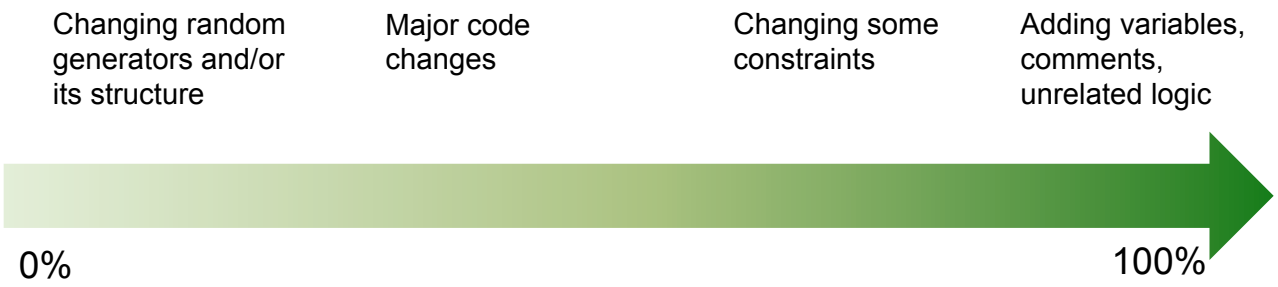
Regression Testing with Random tests cannot separate a regression from new coverage

- Inefficient debugging of regressions
- Unable to separate bad news (regressions) from good news (new coverage)

PinDown solves this:



Random Stability



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:

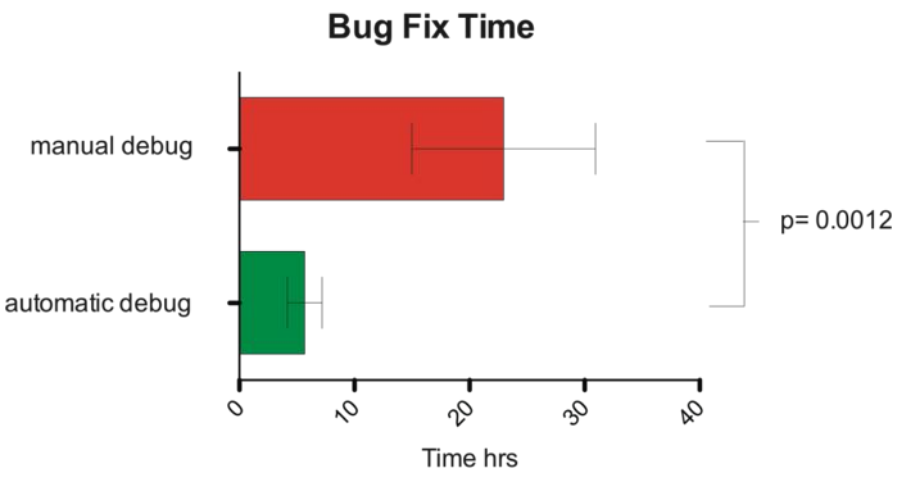
Tracked:
- Device under test (DUT)
- Testbench
- Scripts and tools for build and test

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

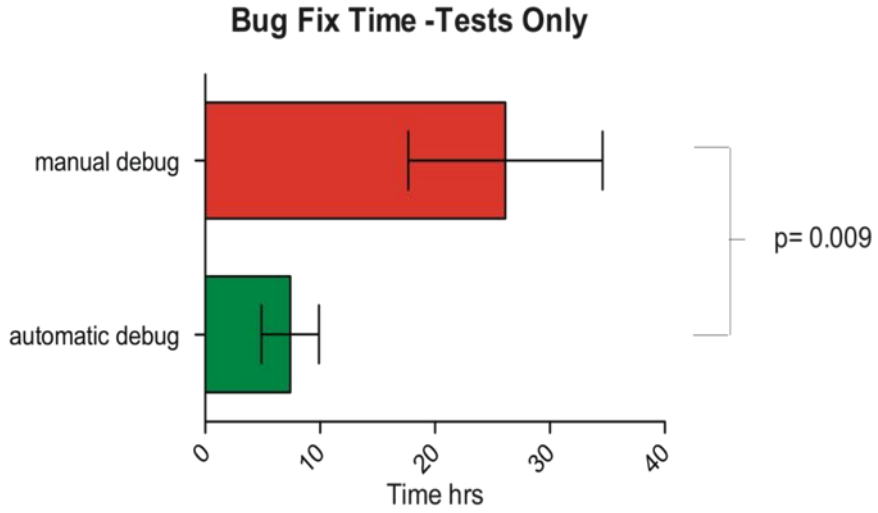
- We measure the time from when the report is emailed out until the fix is committed:

- 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.

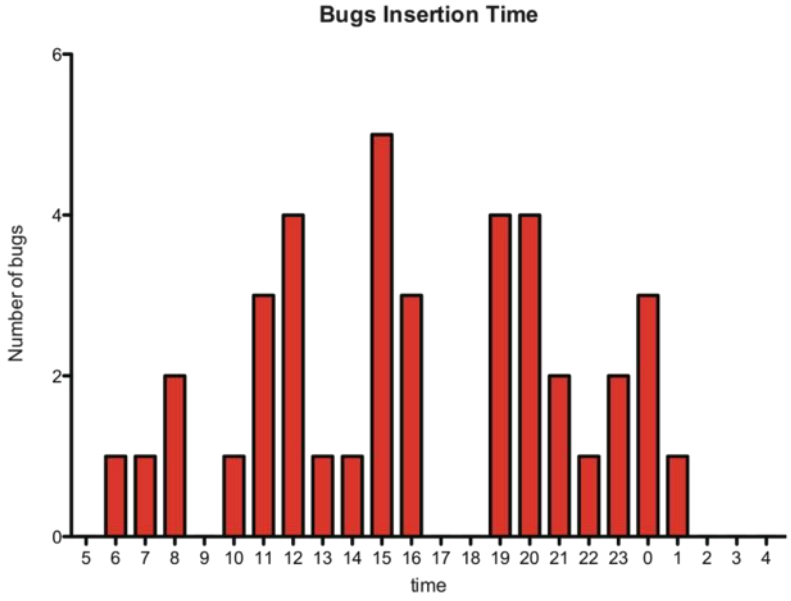
Results: 400% faster bug fixing



(5,7h for automatic debug, 23h for manual debug)



(7,4h for automatic debug, 26,1h for manual debug)



Average insertion time for bugs: 4 pm

5x less discussions
(0,5 emails automatic debug, 2,6 emails manual debug)

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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

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