

Debugging

Michael Hilton

Controversial Statement:

A good design is a **testable**
design

Good Design is about:
Complexity Management
&
Communication

Debugging

Content modified from Andreas Zellers' "Why Programs Fail"

<http://www.whyprogramsfail.com/slides.php>

Worlds' First Bug



Photo # NH 96566-KN (Color) First Computer "Bug", 1947

9/2

9/9


0800 Antan started
 1000 " stopped - antan ✓

13 ⁰⁰ (032) MP-MC	1.130476415	1.2700	9.037 847 025
(033) PRO 2	2.130476415		9.037 846 895 correct
correct	2.130676415		4.615925059(-2)

Relays 6-2 in 033 failed special speed test
 in relay .. 11.00 test.

Relays changed

1100 Started Cosine Tape (Sine check)
 1525 Started Multi-Adder Test.

1545  Relay #70 Panel F
 (moth) in relay.

First actual case of bug being found.

1630 Antan started.
 1700 closed down.

Relay
3145
Relay 3376

FORMULA 1 / AUSTRALIAN GP / BREAKING NEWS

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Mercedes uncovers bug that led to Melbourne defeat



By: **Jonathan Noble**

🕒 Mar 28, 2018, 3:56 PM



Bugs can be VERY tricky to find

tanh(mmalex) @mmalex · 23 Nov 2018
I feel your pain! We had a 'fun' one on LittleBigPlanet 1: 2 weeks to gold, a Japanese QA tester started reliably crashing the game by leaving it on over night. We could not repro. Like you, days of confirmation of identical environment, os, hardware, etc; each attempt took /

4 551 1.6K

tanh(mmalex) @mmalex · 23 Nov 2018
Over 24h, plus time differences, and still no repro. Eventually we realised they had an eye toy plugged in, and set to record audio (that took 2 days of iterating) still no joy. Finally we noticed the crash was always around 4am. Why? What happened only in Japan at 4am? We begged

1 24 373

tanh(mmalex) @mmalex

Follow

Replying to @mmalex @AeornFlippout

To find out. Eventually the answer came: cleaners arrived. They were more thorough than our cleaners! One hour of vacuuming near the eye toy- white noise- caused the in game chat audio compression to leak a few bytes of memory (only with white noise). Long enough? Crash.

3:32 PM - 23 Nov 2018



Bugs are expensive to fix, and can cause real harm

Some estimates put financial losses at between \$22.2 to \$59.5 Billion a year.

People have been hurt, and in some cases even killed (Therac-25, Uber Crash, etc)



Overview

1. The programmer creates a **defect**
2. The defect causes an **infection**
3. The infection **propagates**
4. The infection causes a **failure**

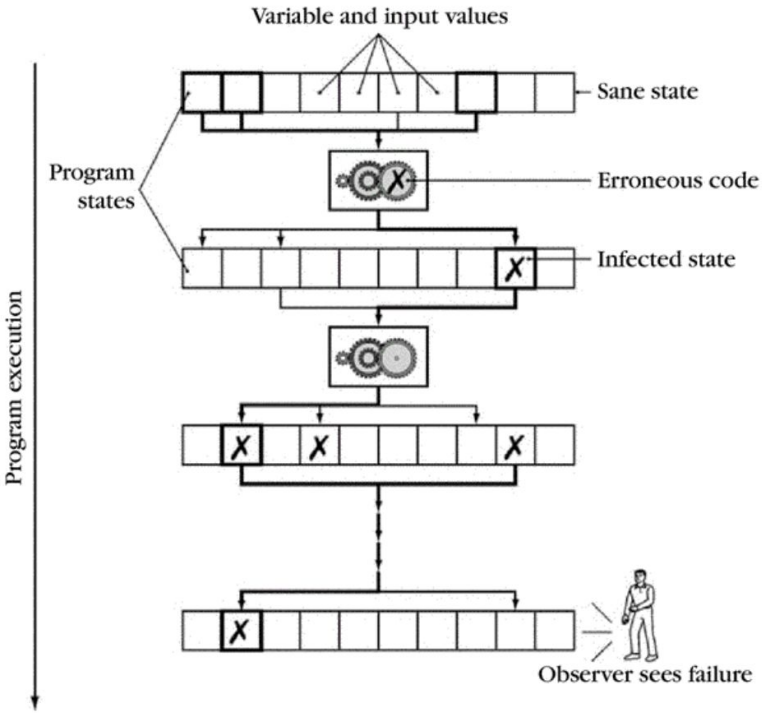
The Curse of Testing

Not every defect causes a failure!

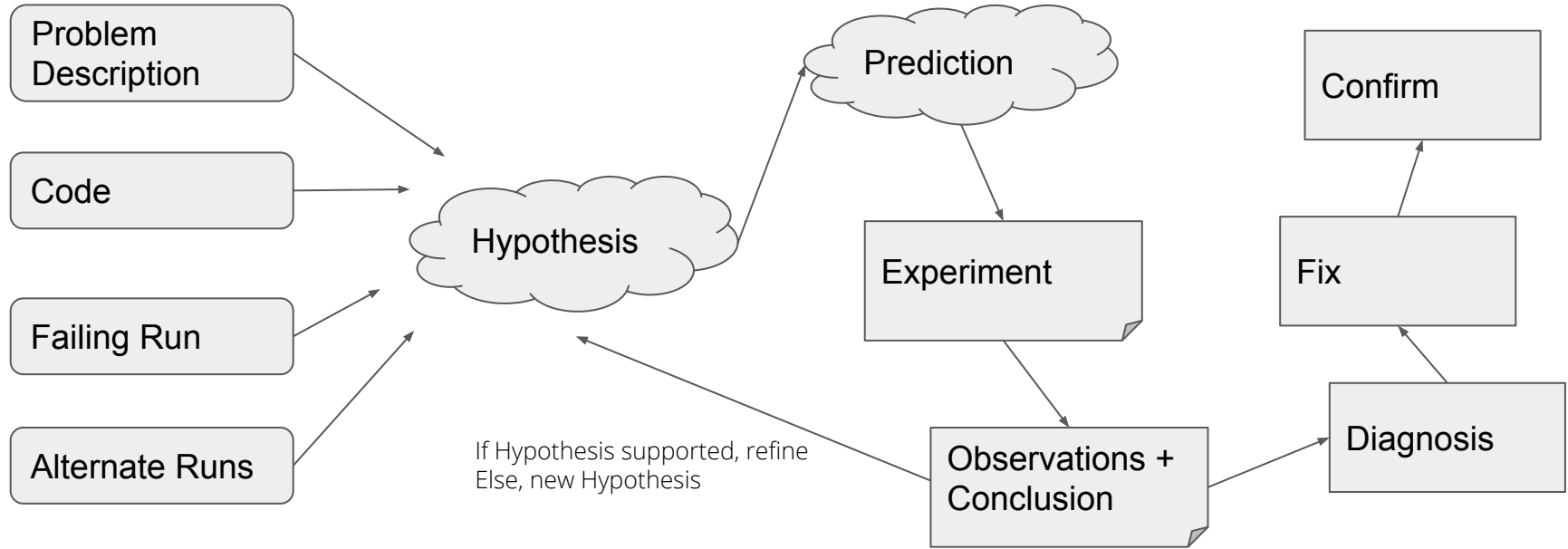
Testing can only show the presence of errors – not their absence. (Dijkstra 1972)



Debugging



Scientific Debugging



Scientific Debugging

Hypothesis:

Prediction:

<http://www.cs.cmu.edu/>

Experiment:

[~mhilton/debugging/](http://www.cs.cmu.edu/~mhilton/debugging/)

Observation:

Conclusion:

Activity:
Developing a debugging process

