

# Famous Software Bugs

CS 272 Software Development

# Software has bugs.



9/9

0800 Andam started  
 1000 " stopped - andam ✓


13<sup>00</sup> (032) MP - MC  $\left\{ \begin{array}{l} 1.2700 \cdot 9.037847025 \\ 1.982647000 \\ 2.130476415 \end{array} \right\}$  9.037846995 correct

(033) PRO 2 2.130476415  
 correct 2.130676415

Relays 6-2 in 033 failed special speed test  
 in relay " 10,000 test -

Relays changed

1700 Started Cosine Tape (Sine check)  
 1525 Started Multi-Adder Test.

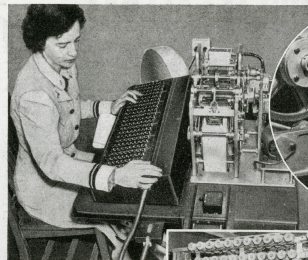
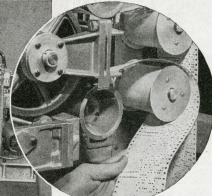
1545  Relay #70 Panel F  
 (moth) in relay.

First actual case of bug being found.

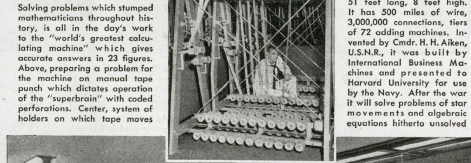
~~1630~~ 1630 Andam started.  
 1700 closed down.

"NH 96566-KN The First 'Computer Bug'" in Naval History and Heritage Command  
<https://www.history.navy.mil/our-collections/photography/numerical-list-of-images/nhcc-series/nh-series/NH-96000/NH-96566-KN.html> and [https://americanhistory.si.edu/collections/search/object/nmah\\_334663](https://americanhistory.si.edu/collections/search/object/nmah_334663)

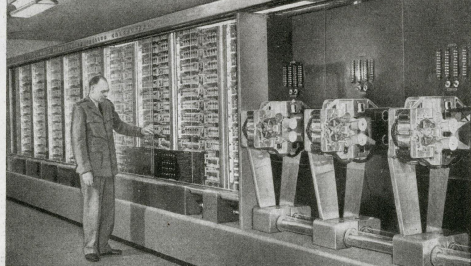
### Robot Works Problems Never Before Solved

Above, tape entering sequence control mechanism shows how problem looks in "punch code." Below, general view of robot which is 51 feet long, 8 feet high. It has 500 miles of wire, 3,000,000 connections. Here of 72 adding machines. Invented by Condi W. K. Aiken, U.S.N.R., it was built by International Business Machines and presented to Harvard University for use by the Navy. After the war it will solve problems of star movements and algebraic equations hitherto unsolved.



Solving problems which stumped mathematicians throughout history, it all in the day's work to the "world's greatest calculating machine" which gives accurate answers in 23 figures. Above, preparing a problem for the machine on a manual tape punch which dictates operation of the "superbrain" with coded perforations. Center, system of holders on which tape moves.



OCTOBER, 1944

Harvard IBM Mark I in CSHI  
<https://chsi.harvard.edu/harvard-ibm-mark-1-about>  
<https://chsi.harvard.edu/harvard-ibm-mark-1-video>

# Why Does Software Have Bugs?

- Complexity
- Human error
- Unclear goals or requirements
- Unrealistic goals or requirements
- Limited resources
- Time, money, expertise
- Poor communication
- Poor management
- And more...

"Why Software Fails" by Robert Charette in IEEE Spectrum on September 2, 2005.

<https://spectrum.ieee.org/computing/software/why-software-fails>



# Bug Discovery and Elimination

- **Able to guarantee there exists a bug**
  - Demonstrate a specific test fails
  - Proves a bug... but is it in software or in the test?
- **Unable to guarantee there are no bugs**
  - Are there bugs in your code?
  - Are there bugs in your tests?
  - Are there bugs in your tests' tests?

# Famous Software Bugs

- **1990 AT&T**

- Bug brings down AT&T's long distance switches
- Leaves 60,000 customers without service for 9 hours

- **1993 Intel**

- Bug in floating-point division in Pentium chips
- Leads to recalls and costs Intel \$475 million

"History's Worst Software Bugs" by Simon Garfinkel in Wired on November 8, 2005.

<https://www.wired.com/2005/11/historys-worst-software-bugs/>



# Famous Software Bugs

- **1962 NASA**

- Bug in transcribing formula into code
- Results in destruction of Mariner 1 space probe

- **1996 ESA**

- Bug in converting 64-bit float to 16-bit signed int
- Caused Ariane 5 rocket (flight 501) to disintegrate

"History's Worst Software Bugs" by Simon Garfinkel in Wired on November 8, 2005.

<https://www.wired.com/2005/11/historys-worst-software-bugs/>



# Famous Software Bugs

- **1985 Therac-25**
  - Bug in radiation therapy device
  - Delivers lethal dose, killing at least 5 patients
- **2000 Multidata**
  - Bug in radiation therapy interface
  - Physicians using it were indicted for murder

"History's Worst Software Bugs" by Simon Garfinkel in Wired on November 8, 2005.

<https://www.wired.com/2005/11/historys-worst-software-bugs/>





# Modern Software Bugs

- "[Knight Capital Says Trading Glitch Cost it \\$440 Million](#)" by Nathaniel Popper in The New York Times on August 2, 2012.
- "[Scary Steam for Linux Bug Erases all the Personal Files on your PC](#)" by Ian Paul in PCWorld on January 17, 2015.
- "[Airbus A350 Software Bug Forces Airlines to Turn Planes Off and On Every 149 Hours](#)" by Careth Corfield in The Register on July 25, 2019.

"List of software bugs" (with significant consequences) on Wikipedia  
[https://en.wikipedia.org/wiki/List\\_of\\_software\\_bugs](https://en.wikipedia.org/wiki/List_of_software_bugs)



# Modern Software Bugs

"Decades-Old Code is Putting Millions of Critical Devices at Risk" by Lily Hay Newman in Wired on October 1, 2019.

*“Nearly two decades ago, a company called Interpeak created a network protocol that became an industry standard. It also had severe bugs that are only now coming to light...”*

"Decades-Old Code is Putting Millions of Critical Devices at Risk" by Lily Hay Newman in Wired on October 1, 2019.  
<https://www.wired.com/story/urgent-11-ipnet-vulnerable-devices/>



# Modern Software Bugs

```
1 if ((err = ReadyHash(&SSLHashSHA1, &hashCtx)) != 0)
2     goto fail;
3 if ((err = SSLHashSHA1.update(&hashCtx, &clientRandom)) != 0)
4     goto fail;
5 if ((err = SSLHashSHA1.update(&hashCtx, &serverRandom)) != 0)
6     goto fail;
7 if ((err = SSLHashSHA1.update(&hashCtx, &signedParams)) != 0)
8     goto fail;
9     goto fail;
10 if ((err = SSLHashSHA1.final(&hashCtx, &hashOut)) != 0)
11     goto fail;
12 err = sslRawVerify( ... )
13 ...
```



"The Apple **goto fail** Vulnerability: Lessons Learned" by David Wheeler in November 23, 2014.

<https://dwheeler.com/essays/apple-goto-fail.html>



# Global Facebook Outage

"Facebook Says A Bug In A Software Audit Tool Triggered Yesterday's Mega Outage" by Martin Giles in Forbes, Oct 2021

*"The result was a cascade of failures. The rogue command took down the backbone's connections... engineers couldn't connect to its data centers remotely... and the outage also took down the tools needed to tackle emergency outages."*

<https://www.forbes.com/sites/martingiles/2021/10/05/audit-software-bug-triggered-facebook-mega-outage/>



# Why Should We Test Software?

- **Software has bugs**
  - Human error, complexity, limited resources, etc.
- **Software bugs are difficult to find and eliminate**
  - Unable to guarantee software is bug-free
- **Software bugs can have serious consequences**
  - Loss of money, reputation, resources, or worse





"All Your Devices can be Hacked" by Avi Rubin at TEDxMidAtlantic on October 2011.

[https://www.ted.com/talks/avi\\_rubin\\_all\\_your\\_devices\\_can\\_be\\_hacked](https://www.ted.com/talks/avi_rubin_all_your_devices_can_be_hacked) · 2015 Update: <https://youtu.be/hhh3U2Swyfg>





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