

Famous Software Bugs

CS 272 Software Development

Software has bugs.



9/9

0800 Andam started
 1000 " stopped - andam ✓
 { 1.2700 · 9.037 847 025
 9.037 846 995 const
~~1.982647000~~
 13⁰⁰ (032) MP - MC 2.130476415 (33) 4.615925059(-2)
 (033) PRO 2 2.130476415
 const 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 Mult+ Adder Test.

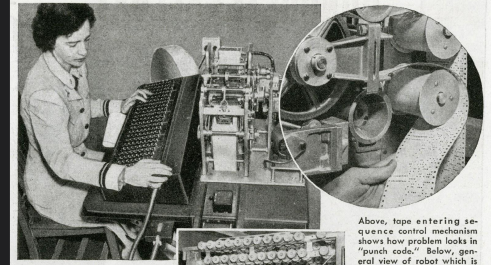
1545 Relay #70 Panel F
 (moth) in relay.



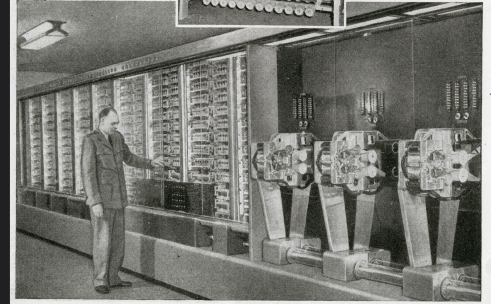
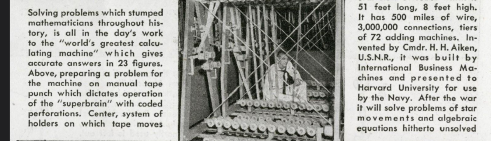
First actual case of bug being found.

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

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 Condr. H. 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



OCTOBER, 1944

"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/nh-series/nh-series/NH-96000/NH-96566-KN.html> and https://americanhistory.si.edu/collections/search/object/nmah_334663

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



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/>



The Log4j security flaw could impact the entire internet. Here's what you should know

By Jennifer Korn

Updated 9:33 AM ET, Thu December 16, 2021

New York (CNN Business) — A critical flaw in widely used software has cybersecurity experts raising alarms and big companies racing to fix the issue.

The vulnerability, which was reported late last week, is in Java-based software known as "Log4j" that large organizations use to configure their applications -- and it poses potential risks for much of the internet.

Apple's cloud computing service, security firm Cloudflare, and one of the world's most popular video games, Minecraft, are among the many services that run Log4j, according to security researchers.

Jen Easterly, head of the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA), called it "one of the most serious flaws" seen in her career. In a [statement](#) on Saturday, Easterly said "a growing set" of hackers are actively attempting to exploit the vulnerability.

As of Tuesday, more than 100 hacking attempts were occurring per minute, according to data this week from cybersecurity firm Check Point.

"It will take years to address this while attackers will be looking... on a daily basis [to exploit it]," said David Kennedy, CEO of cybersecurity firm TrustedSec. "This is a ticking time bomb for companies."

Here's what you should know:

What is Log4j and why does it matter?

Log4j is one of the most popular logging libraries used online, according to cybersecurity experts. Log4j gives software developers a way to build a record of activity to be used for a variety of purposes, such as troubleshooting, auditing and data tracking. Because it is both open-source and free, the library essentially touches every part of the internet.

"It's ubiquitous. Even if you're a developer who doesn't use Log4j directly, you might still be running the vulnerable code because one of the open source libraries you use depends on Log4j," Chris Eng, chief research officer at cybersecurity firm Veracode, told CNN Business. "This is the nature of software: It's turtles all the way down."

<https://www.cnn.com/2021/12/15/tech/log4j-vulnerability/index.html>

Nightmare before Christmas: What to know about the Log4j vulnerability

BY NICOLE SGANGA

UPDATED ON: DECEMBER 17, 2021 / 12:44 PM / CBS NEWS



Now Playing

<https://www.cbsnews.com/news/log4j-vulnerability-breach-patch/>



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 · 2015 Update: <https://youtu.be/hhh3U2Swyfg>





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