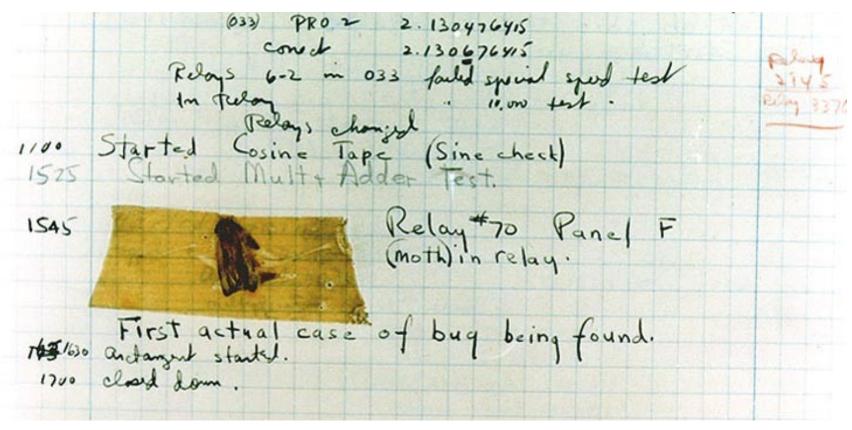


Software Testing

Motivation



Software has bugs.



https://commons.wikimedia.org/wiki/File:H96566k.jpg

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...

http://spectrum.ieee.org/computing/software/why-software-fails/

Bug Finding 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

http://www.wired.com/software/coolapps/news/2005/11/69355

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

http://www.wired.com/software/coolapps/news/2005/11/69355

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

http://www.wired.com/software/coolapps/news/2005/11/69355

More Recent Bugs?

- 2011 Sony: Multiple breaches resulting in theft of credit cards

 http://www.techhive.com/article/226875/sony online entertainment hacked 127

 00 credit cards stolen.html
- 2012 Knight: Bug in HFT software results in \$460 million in losses http://pythonsweetness.tumblr.com/post/64740079543/how-to-lose-172-222-a-second-for-45-minutes
- 2013 Affordable Care Act: Website bugs affect program rollout http://www.npr.org/blogs/itsallpolitics/2013/10/22/239848684/for-democrats-obamacare-web-woes-create-2014-headache

http://en.wikipedia.org/wiki/List_of_software_bugs

Apple Fail 2014

```
if ((err = ReadyHash(&SSLHashSHA1, &hashCtx)) != 0)
      goto fail;
  if ((err = SSLHashSHA1.update(&hashCtx, &clientRandom)) != 0)
      goto fail;
  if ((err = SSLHashSHA1.update(&hashCtx, &serverRandom)) != 0)
      goto fail;
  if ((err = SSLHashSHA1.update(&hashCtx, &signedParams)) != 0)
      goto fail;
 goto fail;
if ((err = SSLHashSHA1.final(&hashCtx, &hashOut)) != 0)
  goto fail;
12 err = sslRawVerify(...)
13 ...
```

http://www.dwheeler.com/essays/apple-goto-fail.html

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

TED: All Your Devices Can Be Hacked by Avi Rubin, 2011



http://www.ted.com/talks/avi_rubin_all_your_devices_can_be_hacked?language=en



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