CSCI 215 Social & Ethical Issues In Computing

Class 13 – Bugs

*Software Bugs and some consequences*

*(Or why you should care about Software quality)*
Notes

• Proposal was due last night
• Recitations (Today/Thursday)
  • This Week: Project
    • Possibly Wednesday Github review
  • Next Week: Midterm Review
  • Roberts 208

• Midterm: Next, next, next Thursday (22 OCT 2015)
Software Bugs

Or why you should care about the quality and design of your code

Where the term “Bug” came from?
Moth trapped in a relay

"H96566k" by Courtesy of the Naval Surface Warfare Center, Dahlgren, VA., 1988
Some really big bugs - SPACE

- **1962 - Mariner I space probe**
  - Paper and Pencil calculation miscopied to computer code when calculating trajectory
    - Official Report: referred to hyphen
    - Others referenced: “overbar transcription error”, or a misplaced decimal point
  - had to crash into Atlantic Ocean less than 5 minutes after take off
  - ~$18.5 Million in (1960’s dollars)
  - Mariner 1 was “wrecked by the most expensive hyphen in history,” ~Arthur C. Clarke
Some really big bugs - SPACE

• 1996 - Ariane 5 Flight 501 - ESA
  • $500 Million Dollars for rocket and cargo
  • Reused Ariane 4 Code, however did not account for upgrades to hardware.
  • 30 seconds into flight, trajectory veered off of flight path due to a bug which reported position 90 degrees off
Some really big bugs - SPACE

1999 – Mars Climate Orbiter
- $193.1 million for spacecraft development
- Engineers failed to convert from English measurements to Metric
- Orbiter flew too close to the planet

Some really big bugs - SPACE

2006 – Mars Global Surveyor
- Launched in 1996
- $154 Million
- It mistakenly thought that motor had failed, and so turned to sun
- Battery overheated

http://apod.nasa.gov/apod/ap970911.html
Some really big bugs - Medical

• **1985-1987 - Therac-25 medical accelerator**
  • Radiation therapy device malfunctions and delivers lethal radiation doses at several medical facilities
  • Built on faulty OS with a race condition
  • At LEAST 5 people died, several injured (including amputations)
Some really big bugs - Medical

• 2000 - Multidata Systems - National Cancer Institute, Panama City
  • Software made by Multidata Systems International in the US to calculate how much radiation to give a patient
  • Not necessarily a bug, but when the doctors used in an unexpected way the calculations were far too high (between 20% - 100% above)
  • at LEAST 8 people died, 20 receive so much radiation it is likely to cause significant health problems
Some really big bugs - Transportation

• 2006 – Malaysia Airlines Jetliner
  • Malaysia Airlines jetliner cruised from Perth, Australia, to Kuala Lumpur, Malaysia
  • Defective software program had provided incorrect data about the aircraft's speed and acceleration, confusing flight computers.
  • Didn’t recognize Pilot’s commands
  • [http://www.wsj.com/articles/SB114895279859065931](http://www.wsj.com/articles/SB114895279859065931)

2015 - Boeing 787 and Airbus A400M

• **Boeing 787**: Federal Aviation Administration warn it is possible for all 4 engines to enter “safety mode” while in flight, locking out the pilot
• **Airbus A400M**: Software improperly set up, test flight crashed in Spain. Killed 4 crew members
Some really big bugs - Transportation

2007 - Toyota electronic throttle control system
  • Faulty software caused vehicle to accelerate uncontrollably, resulting in at least 1 death, possibly up to 89 – *Maybe*

  • **2012**: NASA team issued report that could not conclusively rule out software defects

  • **2013**: Oklahoma court ruled against Toyota
Plug for Software Engineering

• What is ‘software engineering’ (vs say programming)?

• One way we care about quality: Technical Debt
  • E.G. : taking a “short cut” to meet a deadline, it is likely you’ll have to spend more time fixing it later than if you had done it properly to begin with
  • Note, just like financial debt, it is not always bad – it just needs to be managed
Plug for Software Engineering

Example:

• If completed all tickets by 5pm on Friday, company would pay for developers to go to race tracks in Belgrade, as well as pay for lunch

  \[ Cost_{\text{saved}} = \sim 5 \text{ hours} \times \frac{12}{\text{hour}} = 60 \]

  \[ Cost_{\text{paid back}} = \sim 2 \text{ hours} \times 4 \text{ teams} \times \frac{40}{\text{hour}} = 320 \]
Plug for Software Engineering

Martin Fowler’s Technical Debt Quadrant

- Reckless: “We don’t have time for design”
- Prudent: “We must ship now and deal with consequences”
- Deliberate: “What’s Layering?”
- Inadvertent: “Now we know how we should have done it”
Discussion Point

• Other departments in COE have to take the FE exam (Fundamentals of Engineering) exam towards getting their PE
  • It’s a way to tell that the people building our bridges have some sort of background/knowledge on the subject – in other words, are qualified

• There exists a Software Engineering FE exam, do you think it should be a requirement for CS?
Questions?

• **Recitation**: Roberts 208