CSCI 215
Social and Ethical Issues in Computer Science

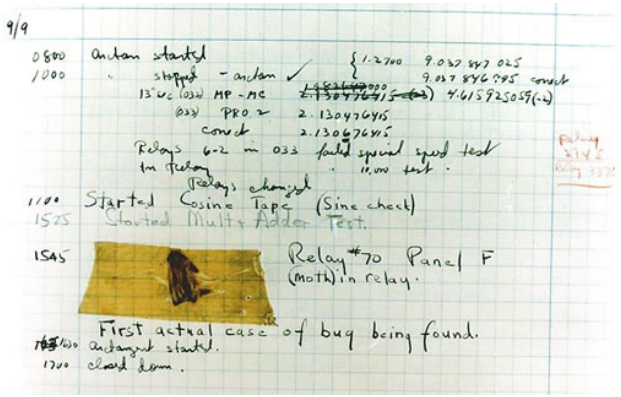
Trust, Safety, and Reliability

Trust, Safety, Reliability

- How might a computer fail to meet expectations?
  - hardware errors
  - software errors (verification)
    - bugs
  - solves the wrong problem (validation)
  - being used for what it wasn't intended
  - user error
  - malice

Debugging

- From Wikipedia
  - The **terms** "bug" and "**debugging**" are popularly attributed to Admiral Grace Hopper in the 1940s. While she was working on a Mark II computer (before shipping to Dahlgren) at Harvard University, her associates (Bill Burke – who later came to Dahlgren as a technician – he taped it in the notebook) discovered a moth stuck in a relay and thereby impeding operation, whereupon she remarked that they were "**debugging**" the system.



The term "debugging" has been associated with machines since the industrial revolution when they had to get termites out of the wooden machines .... the term also became popular when they start discovering viruses and bacteria (bugs).

Safety Critical Software

- What types of software affect someone's safety if it doesn't work properly?
- Air traffic control software
- Controls processes within a nuclear power plant
- Weapon system software
- Braking systems in cars
- Patient monitoring software

Real Time Constraints

- Has to operate within a certain time constraint
  - Example: missile defense
  - If operates correct but late, then it is no good
  - Other examples: aircraft controls, braking systems, pacemakers

Other Considerations

- Embedded software
- Millions of lines of code
- Mixed with commercial software
- Debugging can alter responses

- What types of development can we use with these types of software systems?

Safety Critical Software

- How to ensure reliability?
- Can it be fully tested?
  - What types of testing can be done?
- Maintenance
  - Configuration Management
- Documentation

Student Presentations

Examples of the need for ethics in Computer Science

Calvin, Nicole
Dong, Ruoqing
Hendrickson, LaTrell
Kynett, Nathan

Case Study: Ariane 5 Flight 501

- Ariane 5 rocket
- 1996
- flipped 90 degrees in wrong direction
- Cost $370M
- One of the most expensive software failures in history
- https://www.youtube.com/watch?v=5tJPXYA0Nec

Taken from https://blog.bugsnag.com/bug-day-ariane-5-disaster/

Case Study: NASA travel to International Space Station

- Instead of building and operating its own spacecraft to take astronauts to space as it has in the past, NASA has hired two private companies — Boeing and SpaceX, the aerospace newcomer started by Elon Musk — to provide transportation to and from the International Space Station.

Taken from https://www.nytimes.com/2020/07/07/science/boeing-starliner-nasa.html#:~:text=20%2C%20encountered%20two%20major%20software,Space%20Station%20was%20called%20off.

Case Study: NASA travel to International Space Station

- NASA focused more of its testing (certification) on SpaceX (Crew Dragon)
  - SpaceX - non traditional software development
    - June 2020 – SpaceX successfully sent two astronauts to the space station
  - NASA has worked with Boeing for years
- To save money, NASA did not ask for a management plan from either company which showed how system would be built

Taken from https://www.nytimes.com/2020/07/07/science/boeing-starliner-nasa.html#:~:text=20%2C%20encountered%20two%20major%20software,Space%20Station%20was%20called%20off.

Case Study: NASA travel to International Space Station

- NASA focused on ensuring that Starliner did not pose any danger to the space station as it approached, and software engineering received less attention

Taken from https://www.nytimes.com/2020/07/07/science/boeing-starliner-nasa.html#:~:text=20%2C%20encountered%20two%20major%20software,Space%20Station%20was%20called%20off.

Case Study: NASA travel to International Space Station

- December 2019 – Boeing Test Flight - unmanned
  - landing
  - called Starliner

Taken from https://www.nytimes.com/2020/07/07/science/boeing-starliner-nasa.html#:~:text=20%2C%20encountered%20two%20major%20software,Space%20Station%20was%20called%20off.

Case Study: NASA travel to International Space Station

- 2 major software errors found during the test flight
- The first occurred minutes after the spacecraft had separated from the rocket, because the capsule's clock had been set wrong. That caused the spacecraft to squander its propellant, and a planned docking at the International Space Station was called off.
- Starliner also experienced a communications problem that prevented mission controllers from quickly regaining control. An investigation revealed that the spacecraft's radio receiver had been listening to too wide a swath of frequencies, which led to interference from other transmissions from Earth. Boeing engineers have added a filter to limit the frequencies.
- The second software flaw would have fired the wrong thrusters as Starliner was preparing for re-entry. As Boeing engineers hastily combed through the Starliner software in the aftermath of the clock problem, they found that problem and fixed it. If it had not been fixed, two pieces of Starliner — the capsule that returns to Earth and the service module, which is discarded — might have collided. The capsule might have tumbled and burned up in the atmosphere instead of landing safely in White Sands, N.M.

Taken from https://www.nytimes.com/2020/07/07/science/boeing-starliner-nasa.html#:~:text=20%2C%20encountered%20two%20major%20software,Space%20Station%20was%20called%20off.

Case Study: NASA travel to International Space Station

- What could have prevented this?
  - Testing – Boeing did not perform an end to end test

Questions

- What are the Ramifications?
- Using ACM code of ethics, what are the ethical issues?
- Any others?

Student Presentations

Examples of the need for ethics in Computer Science

Fried, Benjamin
Orelup, Cole
Scallen, Aiden
Weiss, Jared