CS 305: Social, Ethical, and Legal Implications of Computing

Chapter 7: Computer Reliability

Computer reliability

Data reliability

- **Information within a computer system may be incorrect**
- **Examples**
  - **Data entry errors leading to disenfranchised voters**
    - » Florida “felons” of the 2000 general election with only misdemeanor violations
  - **False arrests**
    - » NCIC database incorrectly links people with similar names
    - » Who should be responsible for ensuring accuracy?
    - » What level of integrity should be supported?
    - » Trade-off between false arrests and keeping a lot less records
  - **E-commerce**
    - » 2003 – Amazon misprices iPaQ. Refuses to deliver them at reduced price (275 → 7)

Computer reliability

Software reliability

- May not run properly
- May do unintended actions
- May damage computer system
- May produce other bad data
- Notable malfunctions
  - 1996 – USPS returns 50k letters to USPTO back to sender
  - 2001 – Qwest sends bills that charge $600/minute for calls
  - 2003 – Thailand's finance minister trapped in limo for 10 hours
- Critical system failures
  - London 1992: Ambulatory dispatch system failed. 20 people died waiting
  - Christmas 2004: Comair flight crew assignment system failed. All flights cancelled

Famous computer glitches

AT&T network (1990)

- Single faulty line of code in error-recovery procedure causes tens of millions of dollars in damage
- An OK to a busy switch caused it to fail, reboot, and broadcast OK
  - Rebooting caused traffic to go to other switches, making them busy
  - Broadcast “OK” sent to those switches leftover caused them to fail
  - Cascade of failures caused half of the switches to fail in 10 minutes
- 70 million long-distance calls failed
- 60,000 lost phone service completely

Famous computer glitches

Patriot missile system (1991)

- Failure to fire against a Scud that hit a US Army barracks
- Multiple “range gates” need to be triggered in order to fire a patriot in defense (radar segments)
- Truncation error in system clock accumulated
- Difference in system time and real-time of 0.34 seconds after 100 hours in operation
  - Scanned the incorrect range gate
  - System was only designed to operate several hours at a time before needing to be rebooted!

Famous computer glitches

Ariene 5, 1996

- Rocket system
- Ariene 5 reused software from Ariene 4, but was much faster
  - Assumptions made in software on maximum speed no longer held
  - Conversion between 64-bit float and 16-bit signed int overflowed
  - Exception raised, but not handled by software
- Primary and backup computers crashed
- Rocket destroyed 40 seconds into launch

Famous computer glitches

Intel floating point problem

- **Hmmm..**

```
x = 4195835;
y = 3145727;
z = x - (x/y)*y;
```

- **What is z?**

  a) 256

  b) 0

The fallout

Intel replaced chips that were shown to be defective

- Some replaced, some didn't
- Intel lost a great amount of $$$

Jokes abound…

- Intel's new motto: "United we stand, divided we fall"
- "I heard Intel lost one of its divisions today"
- Q: What's another name for the "Intel Inside" sticker they put on Pentiums?

  A: The warning label.

Software system failures

Therac-25 radiation machine (1985)

- Used to treat cancer
- Electron beams to treat surface tumors
- x-rays to treat deep tumors
- Therac-25 started giving dosages 75-100 times to large to patients
- Many burned, Six killed
- Atomic Energy of Canada Limited – reused code from Therac-6 and Therac-20

Two problems (both race conditions)

- Fast operators could change type of beam, while the magnets were being placed into position. A race condition missed this, causing x-rays to be used instead of electron beams
- Variable used to determine when gun ready to fire. 8-bit variable that was 0 when ready. Task incremented the variable when gun out of position. Could be 0 at times!

Therac-25 post mortem

Flaws abound

- Was not “fail safe”
  - Need to remove single point-of-failure that causes catastrophe
- Lack of software/hardware to detect overdoses

Software lessons

- Debugging concurrent tasks difficult
- Complex, undocumented code is dangerous
- Reuse of code was bad

Therac-25 moral responsibility

Should developers and managers of manufacturer be held responsible?

Therac-25 moral responsibility

Should developers and managers of manufacturer be held responsible?

- Causal condition
  - Were the actions caused by them?
  - Actions and inactions
- Mental condition
  - Did they intend or will the action to happen?
  - Carelessness, recklessness, negligence?

Software engineering

Is quality code a moral obligation for software developers?

If so, then how does one achieve this?

Four main steps to ensure proper software creation

- Specification
- Development
- Validation
- Evolution

How many of you go through these steps?

So software has bugs…

Perfect software in large systems is nearly impossible

What warranties, if any, should be provided by the creator of the software?

- None?
- Some?
- All?

What do other industries do?

- Electronics
- Cars
- Home

Typical software warranty terms

90-day replacement or money back guarantee

Warrants that you can install the software

Software is “As-is”

No warrant and/or liability assumed for

- **Special, incidental, indirect, or consequential damages whatsoever**

Updates may or may not be issued

Are all software warranties enforceable?

Can software companies get away with murder?

Should software fall under Article 2 of Uniform Commercial Code

- Governs sale of products in U.S.
- Requirements for prompt fulfillment and returns of non-conforming goods
- Magnuson-Moss Warranty Act
  - Prevents unfair warranties being placed on products > $25 or on products sold to more than 100 people
  - Ambiguous terminology construed against the drafter of the warranty
  - Defines standards for full versus limited warranties

Let’s get ready to rumble…

Step-Saver Data VS. WYSE & TSL

Step-Saver, a timesharing computer systems provider

TSL, software company that developed Multilink O.S.

Story

- **Step-Saver purchased and resold 142 copies of Multilink OS**
- **TSL said the O.S. was compatible with most DOS applications**
- **Software came with licensing agreement disclaiming all express and implied warranties**
- **Step-Saver software didn't work on Multilink**
  - **Was sued by 12 of its customers**
  - **Step-Saver sued TSL**

Step-Saver Data VS. WYSE & TSL

Court held contract to:

- P.O and invoice
- Oral statements made by TSL representatives
- Written license had different terms that Step-Saver never agreed to
  - President of SS had objected to terms of licensing agreement and refused to sign a document formalizing agreement
- TSL continued to sell Step-Saver Multilink even without the signed written agreement
- Meaning they agreed to the terms of the oral statements

Victory for Step-Saver

ProCD V. Zeindenberg

ProCD sold phone directory data (SelectPhone)

- $10,000,000 invested to construct database
- Had 3000 directories worth of information

Story

- License for consumer version prohibited use of database and program for commercial use (displayed on invocation)
- Zeindenberg bought it for $150
- Sold to other commercial entities for much less
- Got sued… argued that license agreement was not on the outside of the box that the license could not be held

Ruled in favor of ProCD

- Established validity of clickwrapped agreements

Mortenson V. Timberline Software

Timberline had construction bidding package called Precision Bid

License:

**"LIMITATION OF REMEDIES AND LIABILITY
NEITHER TIMBERLINE NOR ANYONE ELSE WHO HAS BEEN INVOLVED IN THE CREATION, PRODUCTION OR DELIVERY OF THE PROGRAMS OR USER MANUALS SHALL BE LIABLE TO YOU FOR ANY DAMAGES OF ANY TYPE, INCLUDING BUT NOT LIMITED TO, ANY LOST PROFITS, LOST SAVINGS, LOSS OF ANTICIPATED BENEFITS, OR OTHER INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PROGRAMS, WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, EVEN IF TIMBERLINE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR FOR ANY OTHER CLAIM BY ANY OTHER PARTY. TIMBERLINE'S LIABILITY FOR DAMAGES IN NO EVENT SHALL EXCEED THE LICENSE FEE PAID FOR THE RIGHT TO USE THE PROGRAMS."**

Mortenson V. Timberline Software (2000)

Story

- Program produced errors “Abort: Cannot find alternate” 19 times on day it was needed to generate a bid
- Mortenson used software and generated a bid for that was $1.95 million too low
- Got the contract
- Mortenson sued Timberline
- Aside: Timberline had fix available and sent it to a few customers in response to problem

Ruled in favor of Timberline

In class exercise

What makes software warranties different than other industries?

Does the cost of having software warranties outweigh the benefits to society?

Do software companies need liability insurance?

In class exercise

You have created a new software package that is destined to become the next great city systems control (e.g. bridges / signal lights / etc) program.

What are you going to supply as part of your "warranty"?

- **Length of time for warranty**
- **Safety to society**
- **Liability (if your program does something wrong)**

Uniform Computer Information Transaction Act

UCITA Features (1999)

- Manufacturers can license software to customers
- Prevent transfer of software between people/orgs
- Can disclaim all liability; customer accepts “as-is”
- Allows manufacturer to remotely disable licensed software in case of license dispute
- Allows manufacturers to collect information about how licensees use their computers
- Applies to software in computers, not embedded

Arguments for UCITA

Article 2 of UCC not appropriate in a digital world

UCITA recognizes no perfect piece of software

Arguments against UCITA

- Customers should be allowed to purchase, not just license
  - If you don't need software, you can't even give it away to anyone to use
- "As-is" removes software companies out of the Magnuson-Moss Act in the UCC
- "Trap doors" are a bad thing
- UCITA was highly controversial. American Legal Institute walked out of proceedings

In class discussion

Should companies be mandated to release a list of known bugs in their software? All bugs? Some bugs?

Should companies be allowed to not fix bugs but just create new versions that the user needs to buy?

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Chapter 8: Professional Ethics

Professional ethics

Many professions have special obligations practitioners must abide by

- **Must be certified and/or accredited to obtain a license to practice**
  - **Psychologists**
  - **Accountants**
  - **Hair stylists**
- **Must agree to a code of ethics to practice**
  - **Lawyers**
  - **Doctors**

Example: CPAs

Certified Public Accountants

- Similar to Computer Science in that it does not require a graduate degree to practice (unlike law or medicine)
- Requirements
  - 150 semester credits of study
  - Practical training of at least 2 years
  - CPA exam
  - To retain certification, must fulfill continuing education requirements and abide by code of ethics

Equivalent Computer Science certification?

- Why?

ACM stance

May 1999

- ACM is opposed to the licensing of software engineers
- ACM believes that it is premature and would not be effective in addressing the problems of software quality and reliability
- No formal certification and licensing, but a code of ethics and professional practice instead

Do you agree?

- Is their ability to harm the public on par with other professions?

Software Engineering Code of Ethics

Eight main principles

- Act consistently with the public interest
- Act in best interests of client and employer, consistent with the public interest
- Ensure products and modifications meet the highest professional standards possible
- Maintain integrity and independence in professional judgment
- Subscribe to and promote an ethical approach to management of software development and maintenance
- Advance the integrity and reputation of profession consistent with the public interest
- Be fair and supportive of colleagues
- Participate in lifelong learning regarding profession and promote an ethical approach to the practice of the profession

Software Engineering Code of Ethics

Not exhaustive

Parts not meant to be used in isolation

Not an algorithm to determine right from wrong

- **Not a mechanical process that leads to a single definitive conclusion for every situation**
- **Based on interpretation and an individual's values (like Utilitarianism)**

Contains pieces from several ethical frameworks

- **Benefits to customer, employer, and public**
- **Treating people as ends**
- **Decisions that hold up to public scrutiny (cultural relativism)**

Acting in the "Public interest"

- **"Virtue" ethics**

Virtue ethics

An ethical framework based on imitation of morally superior role models

- **Acquire a moral virtue by repetition of appropriate acts (e.g. virtue of honesty attained by habitually telling the truth)**
  - **Benevolence, civility, compassion, conscientiousness, cooperativeness, courage, courteousness, dependability, fairness, friendliness, generosity, honesty, industriousness, justice, loyalty, moderation, patience, prudence, reasonableness, self-discipline, self-reliance, tactfulness, thoughtfulness, and tolerance**
- **A person who possesses many moral virtues has strong moral character**
- **Actions taken should be consistent with their character**
- **What would an agent with a virtuous character do in these circumstances?**

Virtue ethics

Strengths

- **No need to be impartial (unlike other ethical frameworks)**
  - **Loyalty and kindness to your children lets you spend money on a trip to Disneyland versus feeding starving children in Africa (contrast to act utilitarianism)**
- **Reject that every action must produce maximum benefit for people overall**

Weaknesses

- **Difficult to determine what to do**
- **Sometimes need to be used in conjunction with other ethical frameworks**
  - **Relative importance of virtues determines which framework**
  - **Example: Multiple fires, but only one fire crew**
    - » Prudence: send crew to minimize property damage (utilitarian)
    - » Justice: send crew to fire within your disctrict

Generalized code of ethics based on virtues

Be impartial

Disclose information others ought to know

Respect the rights of others

Treat others justly

Take responsibility for your actions and inactions

Take responsibility for actions of those you supervise

Maintain your integrity

Continually improve your abilities

Share your knowledge, expertise and values

In class exercise

“Ethical worm” analysis

- Tim releases an anti-worm anonymously to fix a security vulnerability
- Analyze the act according to generalized code of ethics. Which ones are supportive and which ones are not?
  - Be impartial
  - Disclose information others ought to know
  - Respect the rights of others
  - Treat others justly
  - Take responsibility for your actions and inactions
  - Take responsibility for actions of those you supervise
  - Maintain your integrity
  - Continually improve your abilities
  - Share your knowledge, expertise and values

In class exercise

ACME corporation charges for software

- Gold level is 20k per year and comes with support
- Other levels much cheaper but come without support
- An employee of ACME in support secretly takes an outside job running training classes on ACME software at a customer site
- Analyze the act according to code of ethics. Which ones are supportive and which ones are not?
  - Be impartial
  - Disclose information others ought to know
  - Respect the rights of others
  - Treat others justly
  - Take responsibility for your actions and inactions
  - Take responsibility for actions of those you supervise
  - Maintain your integrity
  - Continually improve your abilities
  - Share your knowledge, expertise and values

Whistleblowing

Someone who breaks ranks with an organization to make an unauthorized disclosure of information about a harmful situation after attempts to report it through organizational channels

- **Sometimes valuable, but doesn't necessarily agree with code of ethics**

US legislation

- **False Claims Act (1863)**
  - **Combat fraud during civil war**
  - **Allows citizens to sue (on behalf of the government) a person or company submitting falsified claims to the government**
  - **If found guilty, the citizen received half of settlement**
- **Whistleblower Protection Act (1989)**
  - **Safegaurds for whistleblowers against retribution from their companies**
  - **Appeal to U.S. Merit Systems Protection Board**

Morality of Whistleblowing

Heroes or traitors?

Does motivation matter?

- End wrong-doing versus win money?
- Revenge against former employer or altruism?

Do other circumstances come into play?

- Reveal cover-up that is about to be uncovered

Pros and Cons of whistleblowing

Against

- Corporations condemn it
- Betrayal causes short-term and long-term damage to company
- Public already has recourse through legal system to go after company
- Everyone suffers (company, managers, employee, employee's family)

For

- (Assuming you have tried to handle it internally first)
- Moral responsibility should never be given to others (e.g. managers or executives) otherwise greater harm is done
  - Ford Pinto's gas tank placement
- If non-action might result in serious and considerable harm to the public, you have a moral duty to report it

In class exercise

X hires Y to implement dating service

- Engineer hired by Y to help implement service
- Engineer, not charged with implementing security, finds that usernames and passwords are sent in plain text
- Engineer brings concerns to Y, but Y ignores them and will deliver software to X anyway
- Company Y reminds engineer of confidentiality agreement that forbids her from talking about software to anyone
- Should Engineer do anything?

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Chapter 10: Work and Wealth

Social impacts of technology

Automation and unemployment

- **Goal of economic system is to maximize workforce utilization**
- **Automation presents significant challenges in maintaining employment**
- **Examples?**

  Auto manufacturing
  Postal service
  Pharmacists
  Stock trading

Automation and job creation

- **Reduces prices**
- **Increases demand for product**
- **Increases “real” income of consumers which increases demand for other products**
- **Automating stock trading leads to creation of financial sector jobs up the chain (e.g. mathematicians and computer scientists to build systems)**

Social impacts of technology

Moving the workplace home

- IT allows companies to give “homework”
- Pagers, cell phones, laptops make all time “work-time”
- Forced overtime?

Privacy violations

- Large-scale monitoring of employee and citizen activities

Democratization and flattening of workplace

- IT allows free communication across all employees

Social impacts of technology

Globalization

- Allows jobs to be sent overseas inexpensively
  - Call centers in India
- Arguments for and against?

Talks start next week

See schedule

If you want to use my laptop, send me slides ahead of time so I can check