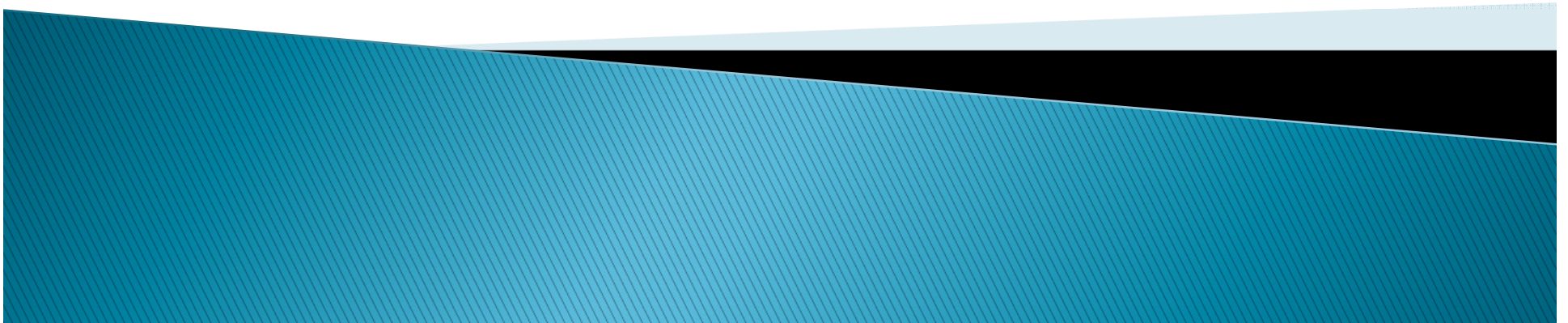# Chapter 8

Sections 1: Failures and Errors in Computers
Section 2: Case Study– Therac 25
By: Alexis Wells

Overview

Section 1

- Complex Computer Systems
- Cause of Computer Glitches
- Avoiding Errors
- Understand Risks and Reasons for Computer Failures
- How to Categorize Computer Errors
- Perspectives of Computer Related Problems

Overview

Section 2
- Therac-25 Radiation Overdoses
- Software & Design Problems
- Re-occurring Incidents
- Observations & Perspectives
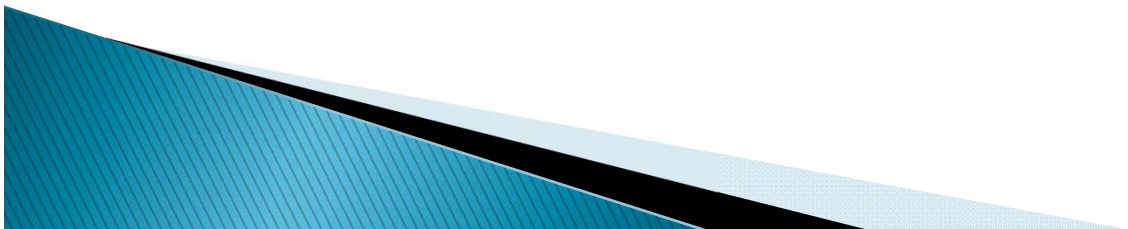
Complex Computer Systems

- "Flaws Found in Software that Tracks Nuclear Material"
- "IRS Computer Sends Bill for $68 Billion in Penalties"
- "Software Glitch Makes Scooter Wheels Suddenly Reverse Direction"
- "Robot Kills Worker"
- "Man Arrested Five Times Due to Faulty FBI Computer Data"

*Almost impossible to create Complex Systems without errors

Cause of Computer Glitches

- Faulty Design
- Sloppy Implementation
- Careless/Insufficiently Trained Users
- Poor User Interfaces

Avoid Errors

- Good Procedures
- Professional Practices for Development & Use

Understand Risks

- How Much Risk Must or Should We Accept?
  - Should systems be 99% or 99.99% accurate
  - If 250 million checks are processed daily and 10,000 are processed incorrectly, is that acceptable?
  - Accuracy Rate better than 99.9%

- How do you Measure Risk?

Perspectives of Computer-Related Problems

- Computer User–understand limitations, proper training, and responsible use

- Computer Professional– Understand source and consequences of computer failures

- Educated Member of Society–understand social, legal, and political decisions dependant on our understanding of risks of computer failures

Categorize Computer Errors & Failures

- Problems for Individuals
- Large Groups/ Cost Large Amounts of money
- Problems in Safety-Critical Systems that may kill or injure people

Problems for Groups

- ## IRS known for Calculation Errors
  - Amounts range from few thousand to $68 billion

- ## Chicago bills cat owners for having dogs
  - Database used "DHC" for domestic house cat & dachshund

- ## Florida Voting in 2000 Election
 - Election officials use list of felons without verification

Problems for Individuals

- Woman Receives $6.3 Million Electricity Bill
  - Input error changed amount from $63

- Man refused credit, unable to purchase house or car
  - Inaccurate middle name entered into database

- Michigan Man Arrested Five Times in 14 Months
  - Case of Identity Theft

Cause of Database Errors

- Large Population
- Automated Processing
- Lack of Human Common Sense
- Unable to Recognize Special Cases
- Over Confidence in Accuracy of Data
- Failure to Update & Correct Errors
- No Accountability for Errors
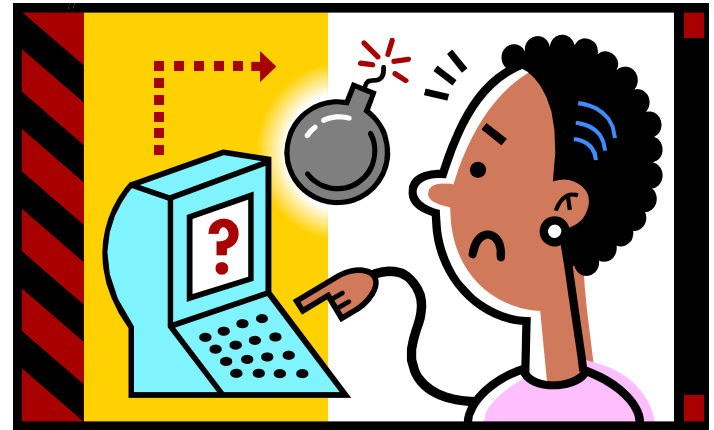
Ways to Minimize Errors

- Check Results
  - Test for Unreasonable Outputs
- Do not rely Solely on Computer Results
  - Use Discretion
- Publicize Software
- Document Work
  - Design Flexibility, expansion, and upgrades
- Distinguish Errors
  - Difference between input error and false reports

Communication, Business, Transportation Failures

- AT&T lost service for 9 hours
  - 50 Million Failed Calls
  - Three-line change in 2 million line telecommunication program
  - Switch tested for 13 weeks prior, but corrections were not retested
- NASDAQ
- Galaxy IV Satellite Failed
  - 85% of pagers were unusable
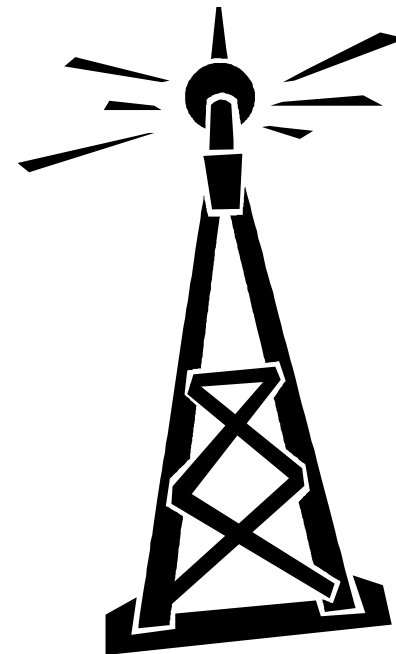
Destroy Business & Careers

- CTB/McGraw–Hill Standardized Test Results
  - Wrong test results reported, lower test scores in multiple states
  - New York: Administration fired and 9,000 children sent to summer school, but scores had risen 5%
  - CTB denied error claims and once corrected failed to inform school districts
- NCR Corporation's Warehouse Manager
  - Original program developed & operated on different operating system than NCR
  - Poor Testing
  - False Reports of success
  - Resulted in Few Dozen Lawsuits

Voting Systems

- Texas
  - 100,000 Extra Votes
  - Votes placed for Wrong Candidates
- North Carolina
  - 400 Votes lost due to technical issues
  - 4,000 Votes Lost, Machine Memory was Full
- Unsecure Machines: Insecure Encryption, lack of security for software, and poor protection of memory cards

Denver Airport

- $3.2 Billion Airport
- Opening Delayed 10 Months
- $193 Million baggage handling system
  - 4,000 Carts, 22 miles of Underground tracks
  - Database: Flights, gates, routing numbers
- Why system Failed?
  - Insufficient time for Development & Testing
  - Specifications Changed after Project Began

# Hong Kong & Kuala Lumpur Airports

- Computer Managed Complex
  ◦ 20,000 pieces of luggage moved per hour
  ◦ Coordinating crews, gates, and flights

- Human Errors are to Blame
  ◦ Wrong information entered into database

Safety-Critical Applications

- A320 Airbus Plane
  - First "fly-by-wire" Air plane
  - Pilots do not control plane
  - Plane directed by pilot inputs into computer
  - Four A320s crashed in Five years
  - Some blame pilots, pilots blame "fly-by-wire"
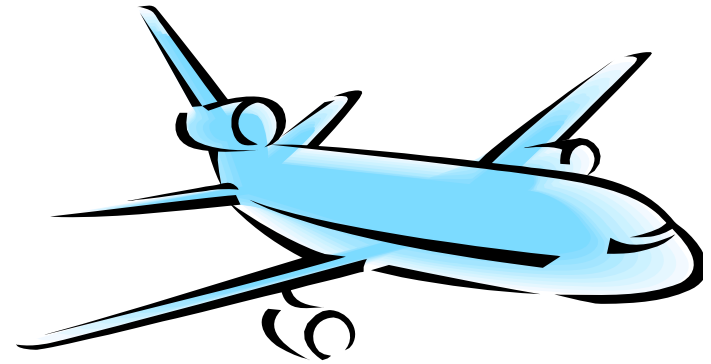
THERAC-25 Radiation Overdoses

- In two years 6 US patients overdosed
- 28 Patients in Panama overdosed

- What was the Cause?
- Why so many?

Cause

- Doctor Entered Treatment Parameters
- Software preformed "Set-Up Checks"
- Checks were Re-run
- Flag variable, stored in one byte, indicated if device was ready
- After device is checked, flag variable is incremented by 1
- 256th check, flag variable reset to zero
- Under certain conditions, equipment would no longer be checked before use

Why So Many?

- Over Confidence
  - Doctors complained, but reassured there was nothing wrong

- User/Maintenance Manual Did not De-code Error messages

- Proper Errors were not addressed
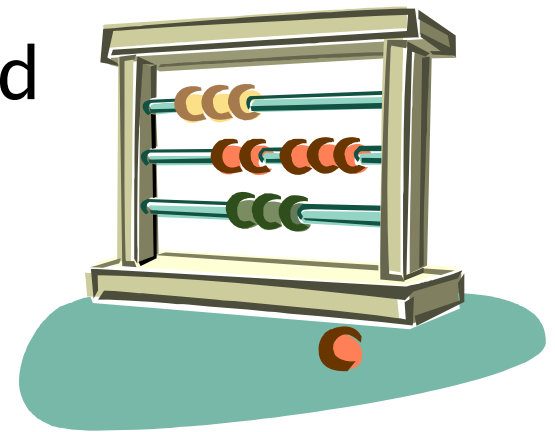
Abandoned Systems

- $500 Million Automated Supply Management System
- $400 Million Purchasing System
- $40 Million Computer Systems
- $125 Million Travel Industry Reservation System
- $100 Million to track Parents who own child support payments
- $4 Billion Tax-System Modernization Plan

Legacy Systems

- Out-of-date systems (hardware, software, or peripheral equipment), with special interfaces, conversion software, and adaptations to interact with more modern systems
- Issues
  - Replacement parts when hardware fails
  - No Programmers; little documentation
  - Older Programming practices
- Why Continued Use
  - Cost
  - Re-Training of staff
  - Conversion of old documents and applications

Why Systems Fail

- Attempt Something Radically New
- Lack of Sufficient Planning
- Insufficient Testing & Training
- Real World Problems
- Problems in Other Systems
- Software Errors
- Large Amounts of Users & Input Data
- Beyond Capabilities of Current Technology
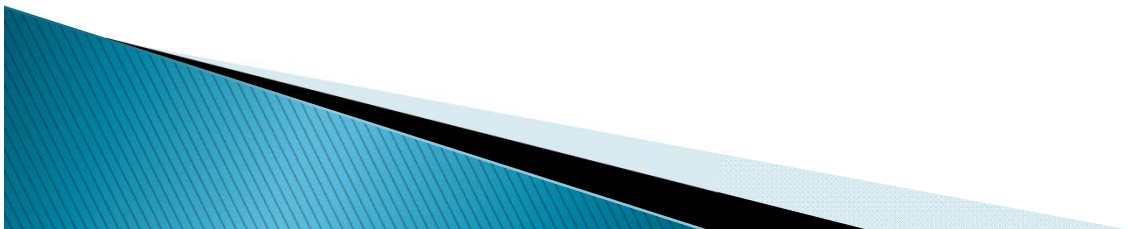
Human Error vs Computer Error

▸ Traffic Collision Avoidance System (TCAS)

▸ Radiation Overdoses in America

▸ Who should have more control, computers or humans?