Lecture 8-1
Computer Reliability
Participation Quiz

1. What is the French word for “eggplant?”
   
   A. のみもの
   B. すきやき
   C. Aubergine
   D. デザート
   E. $&%()@@
Computer Reliability

• Data-Entry and Retrieval errors
  – Voter logs
  – Long gun registry
  – False arrests
  – Credit records

• What responsibility does the maintainer of a database have for the integrity of the data in it? What rights should the people about whom data is stored have to access it, and to have the data corrected?

• There is a tradeoff between making a crime database more extensive and more accurate. How should this tradeoff be managed?
Software and Billing Errors

- **System Malfunctions**
  - Huge bills in the mail
  - Errors in government statistics
  - Mail undelivered
  - Rent system charged people too much

- **System Failures**
  - 911 system had huge delays
  - Errors in stock exchange platforms
  - Air traffic control systems
  - Emergency room scheduling systems
  - Airline scheduling software crash leads to 1100 canceled flights
  - Boeing 777 autopilot malfunction led to erratic flying
Embedded Systems

• Patriot missiles
  – Accumulating floating point truncation errors led them not to fire at incoming missiles

• Ariane 5
  – Floating point to integer conversion error led rocket to explode

• Mars climate orbiter
  – Imperial/metric unit conversion led to crash

• Denver International Airport
  – $311 million automated baggage system never worked, eventually replaced with a $71 million traditional system

• Tokyo stock exchange
  – Accepted an order for selling 610,000 shares at 1 yen, instead of 1 share at 610,000 yen. Then wouldn’t cancel the order.
More Embedded Systems

• Electronic Voting Machines
  – Fails to record various ballots
  – Records way too many votes
  – Records way too few votes
  – Votes recorded correctly but counted wrong (integer overflow)
  – Votes were changed at the confirmation screen

• Therac-25
  – A linear accelerator used to for cancer radiation therapy
  – Occasionally gave patients way too much radiation
  – Traced to various software errors, including two race conditions

• How much should be done to prevent such problems?
• How should we decide that a system is safe?
Computer Reliability

“Self-driving cars should be allowed to operate on public roads once they have been shown to be at least slightly safer than the average human driver.”
Computer Simulations

- Simulations are used to answer questions about scenarios that can’t be easily observed in the real world
  - Hurricanes
  - Nuclear explosions
  - Climate change
  - Car crashes

- Models are only useful if they accurately describe reality

- What would you need to see to trust a simulation?
- How accurate does a simulation have to be to be useful?
Software Warranties

• Software companies tend to write license agreements saying that the software may not perform as promised
  – “we expressly disclaim ... the implied warranties of merchantability and fitness for a particular purpose”

• Why is this reasonable?
  – Software is expensive
  – Other expensive goods are backed up by warranties

• Should software come with warranties? If so, what should these warranties cover?

• Do software makers have a moral obligation to produce software that does what it promises?