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. $&%()@@
“Canadians should have the right to vote online in federal, provincial and municipal elections.”
Online Voting

• Motivation:
  – More people would vote
  – Votes would be counted more quickly
  – Cost less money
  – Avoid disputed elections like Florida 2000
  – Eliminate ballot box tampering
  – Software can prevent accidental over-, under-voting

• Risks:
  – Gives unfair advantage to those with home computers
  – More difficult to preserve voter privacy
  – More opportunities for vote selling
  – Obvious target for a DDoS attack
  – Security of election depends on security of home computers
  – Susceptible to phony vote servers
  – No paper copies of ballots for auditing or recounts
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?
“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?