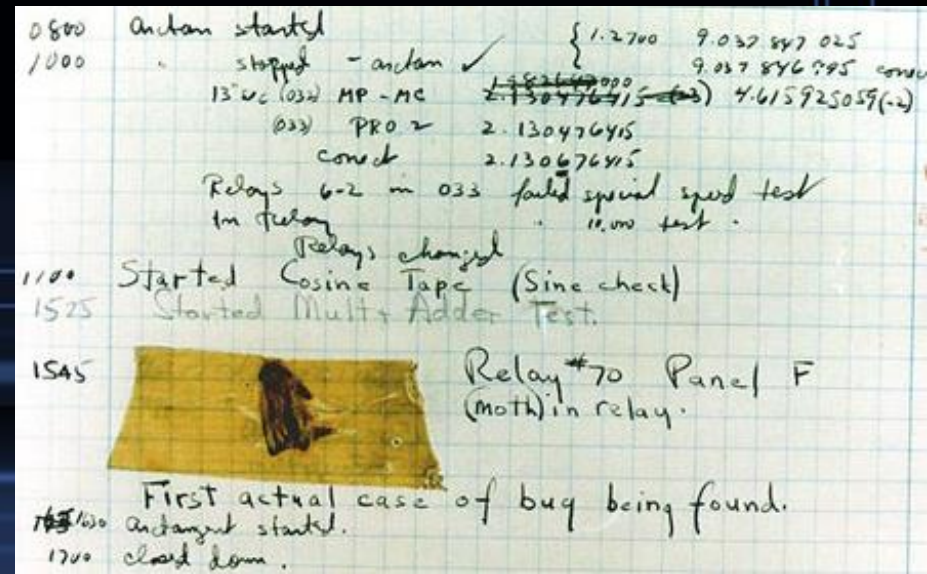Tyler Grondahl

# FAMOUS BUGS (ERRORS) AND WHAT CAUSED THEM

# History of the Software Bug

- The Middle English word *bugge* is a term used for a monster

- 1878 – Thomas Edison said "…bugs – as such little faults and difficulties are called…"

- 1931 – Baffle Ball advertised as "free of bugs"

- 1945 – Harvard team working on Mark II finds moth in one of the relays

# Mariner 1 (1962)

- Five minutes into Mariner 1's launch it began to yaw off course
- The rocket was headed straight towards North Atlantic shipping lanes
- The range safety officer ordered a self-destruct
- Engineer wrote '¯' and the programmer typed –
- Cost: $145.1 million
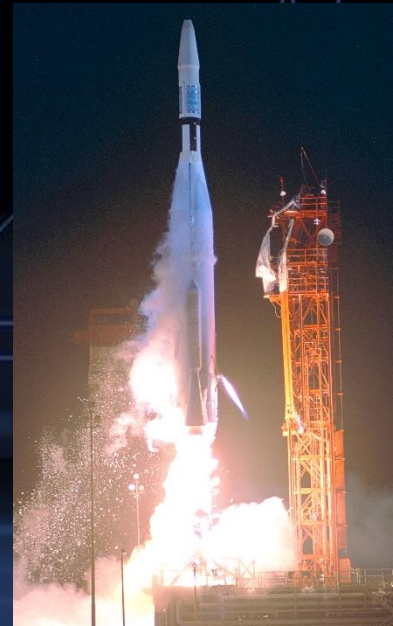
# Therac-25 Medical Accelerator Disaster (1985)

- Therac-25 was a radiation therapy machine used in the treatment of cancer patients

- Two modes: precision electron beam and a megavolt X-ray mode which required shielding, filters, and an ion chamber to keep beams safely on target

- Some patients exposed to megavolt X-rays on accident

- Caused by race condition in the software

- Cost: 6 radiation overdoses
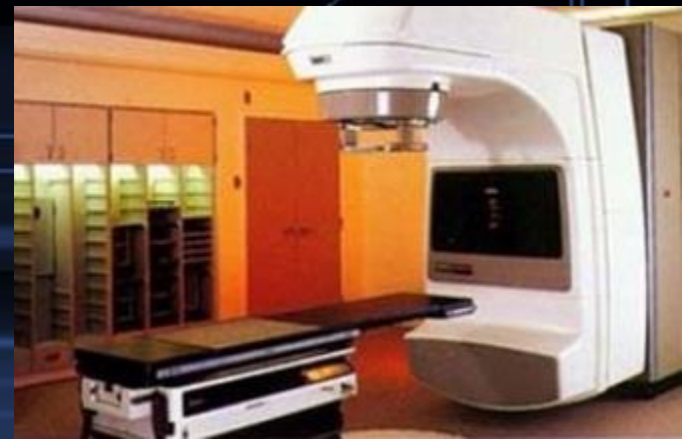
# AT&T Long-Distance Bug (1990)

- January 15, 1990 – 60,000 long distance calls failed
- All 144 4ESS long-distance switches were stuck in reboot loops
- AT&T thought it was being hacked for nine hours
- If one switch gets congested, sends "do not disturb" message to the next switch
- The second switch reboots itself to prepare for extra traffic
- Process sped up and led to loop
- Cost: $108.76 million

# Patriot Missile Accident (1991)

- Patriot missiles used to protect against Iraqi-fired SCUD missiles during the first Persian Gulf War
- 42 Patriot missiles were successfully launched during that conflict, but one was unsuccessful
- The failed missile never launched over the U.S. base in Dhahran, Saudi Arabia
- Caused by clock time being off
- Cost:  28 lives

# Correctly Calculated Range Gate

**3 - Track action**
The system tracks the object in the defined range and filters out objects outside the gate (brown portion). Finding an object within the calculated range gate area confirms that it is a Scud missile.
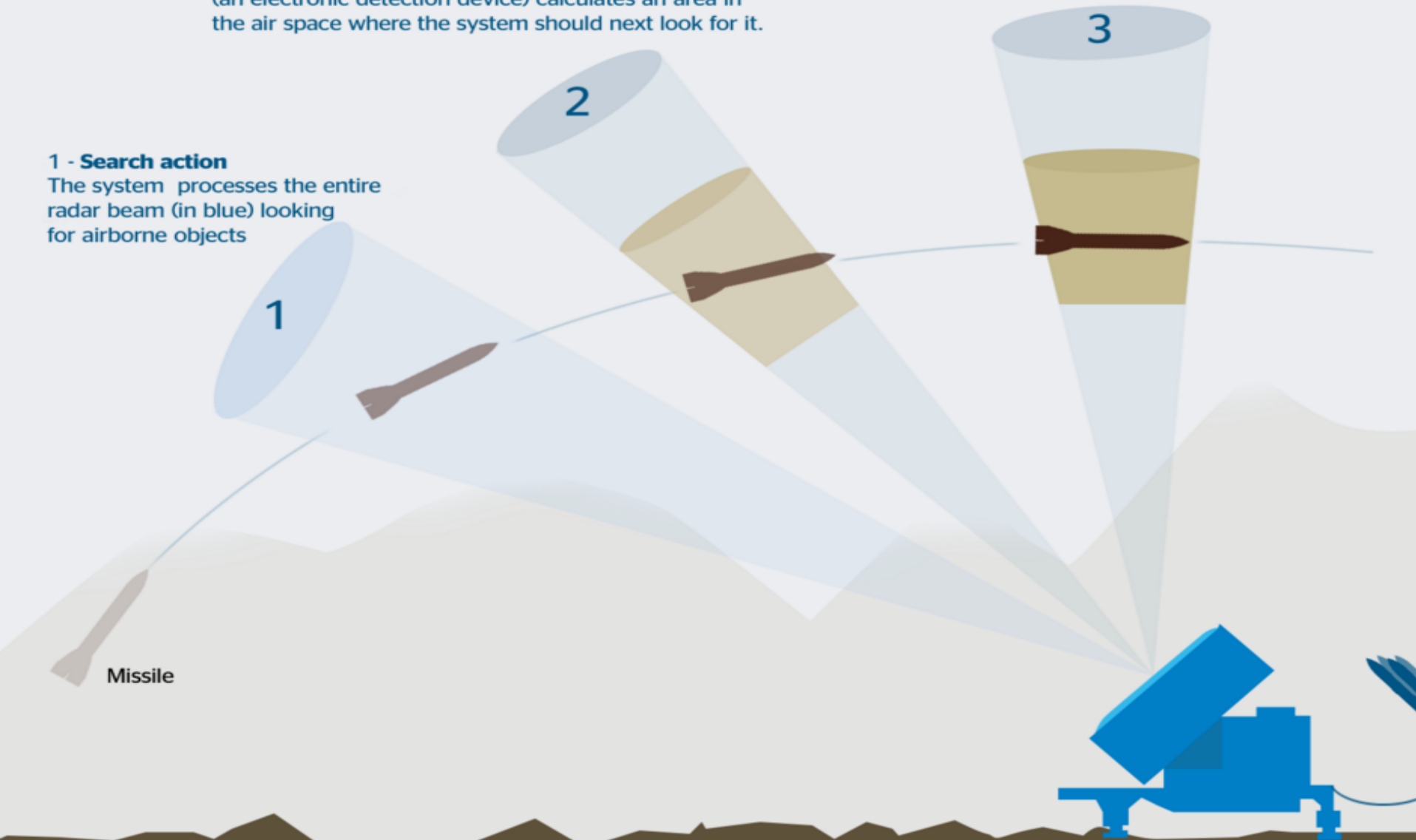
**2 - Validation action**
After the Patriot's radar detects a Scud, the range gate (an electronic detection device) calculates an area in the air space where the system should next look for it.

**1 - Search action**
The system processes the entire radar beam (in blue) looking for airborne objects

3

2

1

Missile

# Incorrect calculation (bug)

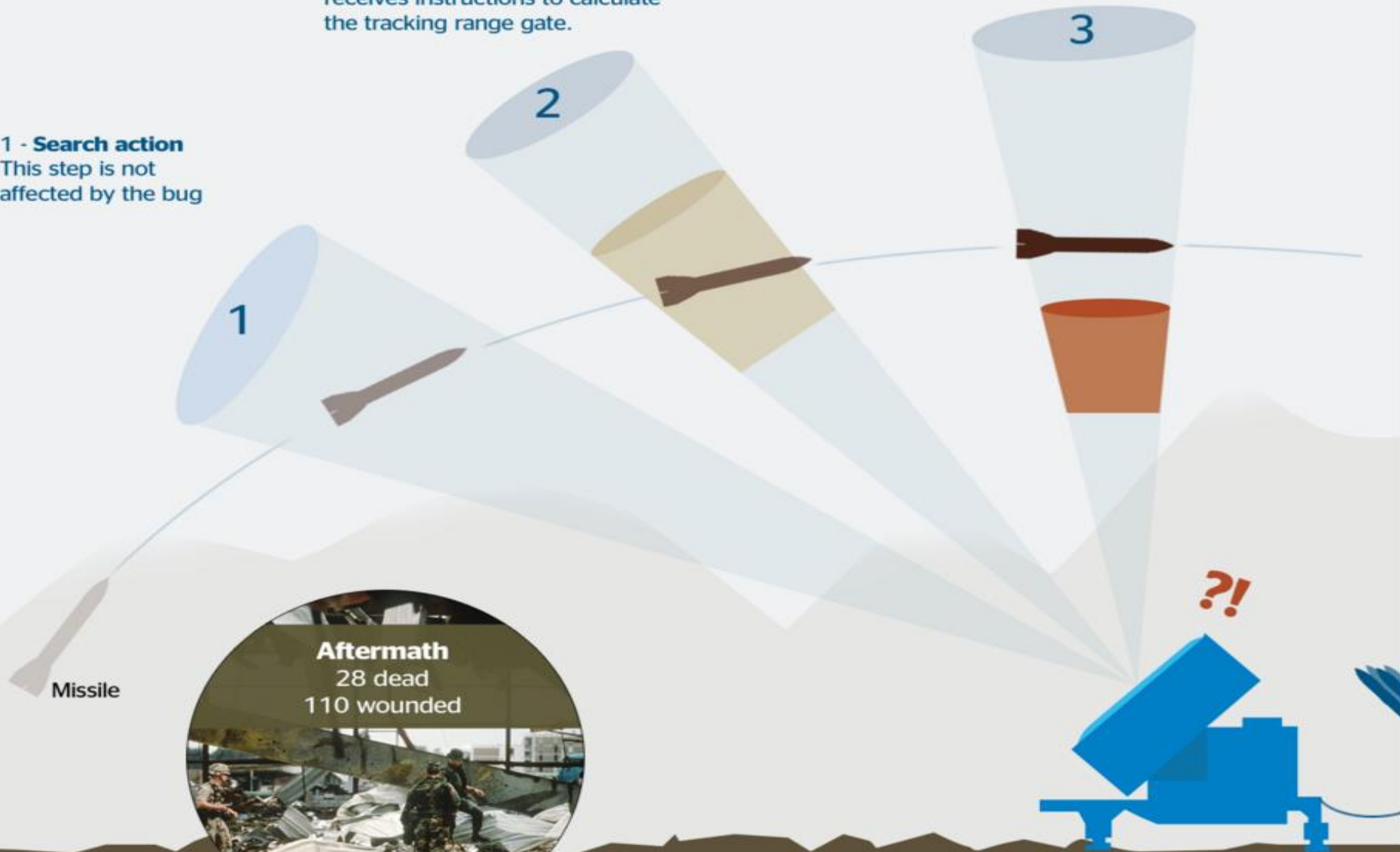**2 - Validation action**
The target is validated and the system receives instructions to calculate the tracking range gate.

**3 - Track action**
This is where everything goes wrong: The range gate prediction of where the Scud would be next is miscalculated by more than 600 meters.

3

2

**1 - Search action**
This step is not affected by the bug

1

Missile

**Aftermath**
28 dead
110 wounded

?!

# Pentium Floating-Point Miscalculations (1994)

- Intel launched Pentium processor in March 1993
- Intel implemented lookup tables for floating points
- Some table entries did not make it onto the chip
- 1-in-9 billion chance of a miscalculation
- Intel discovered bug in June 1994
- In October 1994, math professor Thomas Nicely discovered miscalculations with floating points
- Cost:  $759.4 million

# Ariane-5 (1996)

- European Space Agency (ESA) launched this satellite
- Thirty seconds into liftoff it lost guidance and altitude information
- Veered completely off-course and automatically self-destructed in 40 seconds
- Caused by inertial reference system converting a 64-bit float to a 16-bit signed integer which produced an overflow error
- Cost: $254 million

# Mars Climate Orbiter (1998)

- Robotic space probe manufactured by Lockheed Martin and launched by NASA

- Goals were to study the Martian climate, atmosphere, and surface changes

- Miscalculated trajectory and burned up in Mars's atmosphere

- Error due to one team using the Imperial system and the other team using the metric system

- Cost: $327.6 million

# Northeast Blackout (2003)

- 50 million people lost power during a heatwave
- Some power restored earliest after seven hours
- Most did not get power restored until two days later
- Caused by race condition in the control software
- Cost: $10 billion and 11 lives

# Windows Genuine (Dis)Advantage (2006)

- There was no real advantage to Windows Genuine Advantage

- Microsoft released it to reduce software piracy

- An individual on the WGA team accidentally pushed faulty software to the WGA servers

- For 19 hours, thousands of Windows customers were falsely flagged for using "pirated" Windows

- XP users had an annoying popup but Vista users had some Windows features disabled entirely

- Cost: Bad PR

⚠ **You may be a victim of software counterfeiting.** ✕
This copy of Windows is not genuine. Click this balloon to resolve now.

# Knight Capital (2012)

- Firm that specializes in executing trades for retail brokers
- Their software ran a trading algorithm that focused on a stock's bid and ask price
- During a test-run the software flipped the bid and asking price
- This resulted in instantaneous losses up to 40 trades per second which went on for 45 minutes
- Cost:  $440 million