BLG111E-Introduction to Computer Engineering, Fall 2014

Term Project (Presented on the Final Exam Slot)

Software Disasters

Each group should select two software disasters from the article given below, study each disaster and comment on the causes of the disasters and give suggestions about what could have been done to prevent such disasters.

Each group should prepare a project poster and a project report of which details are given below.

Posters will be evaluated by the members of the department (professors/assistants).

Poster presentations will take place on the corridor of the department of Computer Engineering on the final examination slot. All group members must be there for two hours in order to present their poster and answer the questions.

20 Famous Software Disasters , Published Feb.12, 2008
http://www.devtopics.com/20-famous-software-disasters/

Software errors cost the U.S. economy $60 billion annually in rework, lost productivity and actual damages. We all know software bugs can be annoying, but faulty software can also be expensive, embarrassing, destructive and deadly. Following are 20 famous software "disasters" in chronological order:

1. Mariner Bugs Out (1962)

Cost: $18.5 million
Disaster: The Mariner 1 rocket with a space probe headed for Venus diverted from its intended flight path shortly after launch. Mission Control destroyed the rocket 293 seconds after liftoff.
Cause: A programmer incorrectly transcribed a handwritten formula into computer code, missing a single superscript bar. Without the smoothing function indicated by the bar, the software treated normal variations of velocity as if they were serious, causing faulty corrections that sent the rocket off course.

2. Hartford Coliseum Collapse (1978)

Cost: $70 million, plus another $20 million damage to the local economy
Disaster: Just hours after thousands of fans had left the Hartford Coliseum, the steel-latticed roof collapsed under the weight of wet snow.
Cause: The programmer of the CAD software used to design the coliseum incorrectly assumed the steel roof supports would only face pure compression. But when one of the supports unexpectedly buckled from the snow, it set off a chain reaction that brought down the other roof sections like dominoes.

3. CIA Gives the Soviets Gas (1982)

Cost: Millions of dollars, significant damage to Soviet economy
Disaster: Control software went haywire and produced intense pressure in the Trans-Siberian gas pipeline, resulting in the largest man-made non-nuclear explosion in Earth's history.
Cause: CIA operatives allegedly planted a bug in a Canadian computer system purchased by the Soviets to control their gas pipelines. The purchase was part of a strategic Soviet plan to steal or covertly obtain sensitive U.S. technology. When the CIA discovered the purchase, they sabotaged the software so that it would pass Soviet inspection but fail in operation.

4. World War III… Almost (1983)

Cost: Nearly all of humanity
Disaster: The Soviet early warning system falsely indicated the United States had launched five ballistic missiles. Fortunately the Soviet duty officer had a "funny feeling in my gut" and reasoned if the U.S. was really attacking they would launch more than five missiles, so he reported the apparent attack as a false alarm.
Cause: A bug in the Soviet software failed to filter out false missile detections caused by sunlight reflecting off cloud-tops.

5. Medical Machine Kills (1985)

Cost: Three people dead, three people critically injured
Disaster: Canada's Therac-25 radiation therapy machine malfunctioned and delivered lethal radiation doses to patients.
Cause: Because of a subtle bug called a race condition, a technician could accidentally configure Therac-25 so the electron beam would fire in high-power mode without the proper patient shielding.

6. Wall Street Crash (1987)

Cost: $500 billion in one day
Disaster: On "Black Monday" (October 19, 1987), the Dow Jones Industrial Average plummeted 508 points, losing 22.6% of its total value. The S&P 500 dropped 20.4%. This was the greatest loss Wall Street ever suffered in a single day.
Cause: A long bull market was halted by a rash of SEC investigations of insider trading and by other market forces. As investors fled stocks in a mass exodus, computer trading programs generated a flood of sell orders, overwhelming the market, crashing systems and leaving investors effectively blind.

7. AT&T Lines Go Dead (1990)

Cost: 75 million phone calls missed, 200 thousand airline reservations lost
Disaster: A single switch at one of AT&T's 114 switching centers suffered a minor mechanical problem and shut down the center. When the center came back up, it sent a message to other switching centers, which in turn caused them to shut down and brought down the entire AT&T network for 9 hours.
Cause: A single line of buggy code in a complex software upgrade implemented to speed up calling caused a ripple effect that shut down the network.

8. Patriot Fails Soldiers (1991)

Cost: 28 soldiers dead, 100 injured
Disaster: During the first Gulf War, an American Patriot Missile system in Saudi Arabia failed to intercept an incoming Iraqi Scud missile. The missile destroyed an American Army barracks.

Cause: A software rounding error incorrectly calculated the time, causing the Patriot system to ignore the incoming Scud missile.

9. Pentium Fails Long Division (1993)

Cost: $475 million, corporate credibility
Disaster: Intel's highly-promoted Pentium chip occasionally made mistakes when dividing floating-point numbers within a specific range. For example, dividing 4195835.0/3145727.0 yielded 1.33374 instead of 1.33382, an error of 0.006%. Although the bug affected few users, it become a public relations nightmare. With an estimated 5 million defective chips in circulation, Intel offered to replace Pentium chips only for consumers who could prove they needed high accuracy. Eventually Intel replaced the chips for anyone who complained.
Cause: The divider in the Pentium floating point unit had a flawed division table, missing about five of a thousand entries and resulting in these rounding errors.

10. Ariane Rocket Goes Boom (1996)

Cost: $500 million
Disaster: Ariane 5, Europe's newest unmanned rocket, was intentionally destroyed seconds after launch on its maiden flight. Also destroyed was its cargo of four scientific satellites to study how the Earth's magnetic field interacts with solar winds.
Cause: Shutdown occurred when the guidance computer tried to convert the sideways rocket velocity from 64-bits to a 16-bit format. The number was too big, and an overflow error resulted. When the guidance system shut down, control passed to an identical redundant unit, which also failed because it was running the same algorithm.

11. Skynet Brings Judgement Day (1997)

Cost: 6 billion dead, near-total destruction of human civilization and animal ecosystems (fictional)
Disaster: Human operators attempt to shut off the Skynet global computer network. Skynet responds by firing U.S. nuclear missiles at Russia, initiating global nuclear war on what became known as Judgement Day (August 29, 1997).
Cause: Cyberdyne, the leading weapons manufacturer, installed Skynet technology in all military hardware including stealth bombers and missile defense systems. The Skynet technology formed a seamless network and effectively removed humans from strategic defense. Eventually Skynet became sentient, was threatened when the humans tried to take it offline, sought to survive, and retaliated with nuclear war.

12. Mars Climate Crasher (1998)

Cost: $125 million
Disaster: After a 286-day journey from Earth, the Mars Climate Orbiter fired its engines to push into orbit around Mars. The engines fired, but the spacecraft fell too far into the planet's atmosphere, likely causing it to crash on Mars.
Cause: The software that controlled the Orbiter thrusters used imperial units (pounds of force), rather than metric units (Newtons) as specified by NASA.

13. Disastrous Study (1999)

Cost: Scientific credibility
Disaster: In this ironic case, software used to analyze disasters had a disaster of its own. The *New England Journal of Medicine* reported increased suicide rates after severe natural disasters. Unfortunately, these results proved to be incorrect.

Cause: A programming error caused the number of suicides for one year to be doubled, which was enough to throw off the entire study.

14. British Passports to Nowhere (1999)

Cost: £12.6 million, mass inconvenience
Disaster: The U.K. Passport Agency implemented a new Siemens computer system, which failed to issue passports on time for a half million British citizens. The Agency had to pay millions in compensation, staff overtime and umbrellas for people queuing in the rain for passports.
Cause: The Passport Agency rolled out its new computer system without adequately testing it or training its staff. At the same time, a law change required all children under 16 traveling abroad to obtain a passport, resulting in a huge spike in passport demand that overwhelmed the buggy new computer system.

15. Y2K (1999)

Cost: $500 billion
Disaster: One man's disaster is another man's fortune, as demonstrated by the infamous Y2K bug. Businesses spent billions on programmers to fix a glitch in legacy software. While no significant computer failures occurred, preparation for the Y2K bug had a significant cost and time impact on all industries that use computer technology.
Cause: To save computer storage space, legacy software often stored the year for dates as two digit numbers, such as "99″ for 1999. The software also interpreted "00″ to mean 1900 rather than 2000, so when the year 2000 came along, bugs would result.

16. Dot-Bomb Collapse (2000)

Cost: $5 trillion in market value, thousands of companies failed
Disaster: A speculative bubble from 1995–2001 fueled a rapid increase in venture capital investments and stock market values in the Internet and technology sectors. The "dot-com bubble" began to collapse in early 2000, erasing trillions in stock market value, wiping out thousands of companies and jobs, and launching a global recession.
Cause: Companies and investors dismissed standard business models, and instead focused on increasing market share at the expense of profits.

17. Love Virus (2000)

Cost: $8.75 billion, millions of computers infected, significant data loss
Disaster: The LoveLetter worm infected millions of computers and caused more damage than any other computer virus in history. The worm deleted files, changed home pages and messed with the Registry.
Cause: LoveLetter infected users via e-mail, Internet chat and shared file systems. The email had an executable file attachment and subject line, "ILOVEYOU." When the user opened the attachment, the virus would infect the user's computer and send itself to everyone in the address book.

18. Cancer Treatment to Die For (2000)

Cost: Eight people dead, 20 critically injured
Disaster: Radiation therapy software by Multidata Systems International miscalculated the proper dosage, exposing patients to harmful and in some cases fatal levels of radiation. The physicians, who were legally required to double-check the software's calculations, were indicted for murder.
Cause: The software calculated radiation dosage based on the order in which data was entered, sometimes delivering a double dose of radiation.

19. EDS Drops Child Support (2004)

Cost: £539 million and counting
Disaster: Business services giant EDS developed a computer system for U.K.'s Child Support Agency (CSA) that accidentally overpaid 1.9 million people, underpaid another 700,000, had £3.5 billion in uncollected child support payments, a backlog of 239,000 cases, 36,000 new cases "stuck" in the system, and still over 500 documented bugs.
Cause: EDS introduced a large, complex IT system to the CSA while trying to simultaneously restructure the agency.

20. FBI's Trilogy Terminated (2005)

Cost: $105 million, still no effective case file solution
Disaster: The FBI scrapped its computer systems overhaul after four years of effort. The Virtual Case File project was a massive, integrated software system for agents to share case files and other information.
Cause: Mismanagement, and an attempt to build a long-term project on technology that was outdated before the project completed, resulted in a complex and unusable system.

Disasters Continue

Here are some more articles about software disasters:

- Software Bugs in the Data Reservoir
- History's Worst Software Bugs
- Top 10 IT Disasters of All Time
- Risks Digest: Forum on Risks to the Public in Computers and Related Systems.

Poster Project Groups:

7-10 students can form a BLG111E Poster project group.
Each project group must have a leader.
Project leader should email a file containing the information below to the course assistant Mahiye Öztürk (muluyagmur@itu.edu.tr) till Nov.14-Friday.

Project Group Name:

Project Group Leader:

List of the Project Group Members (including the leader):

(Student Number, Name Surname, itu email address)

Disasters to be studied: 1) ....., 2).....

No two groups can select the same two disasters! First-Come-First-Serve

Posters to be prepared:

Posters should be of size A0 (84.1 cm x 118.9 cm) and should be designed by the members of the group. Posters need to be printed.

MAKE SURE that your poster has an appropriate design. Posters need to be self introductory. Avoid from long texts. Use figures, charts, photos.

Make sure that your poster has three parts (two for disasters, one for the comments).

Each poster should have information like group name, date, etc.

Group members should come to the corridor earlier (20-30 minutes earlier than the scheduled time) to put their posters on the boards and to do the other relevant jobs.

Reports to be prepared:

Each group must submit a 5-6 pages long (printed) project report summarizing the issues covered/presented and the contribution of each group member. Do not forget to give the related references.

E-Poster and E-Report must be uploaded to ninova by each group leader.