**Assignment 1**

**Assignment on: 5 Software Failure Case Studies**

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Software systems have become the backbone of almost all the organizations worldwide. Adoption of smartphones has made access to software applications more of a convenience and necessity. That's why, how much ever we try to avoid them we end up using software systems in our daily life as a person and as an organization. With over 4.1 billion [1] of the world population on the Internet and rapid modernization of countries across the world, it has become inevitable to avoid the software footprint in your everyday life.

With mission-critical and high-risk applications which have human lives and resources on risk depending on software applications, testing not only for expected but aiming for zero defects is required. We have listed 5 software failures which resulted in severe disruption and loss of resources in the current year which could have been avoided.

# Patriot Missile Failure

On February 25, 1991 (during the first Gulf War), an American Patriot Missile system in Dharan, Saudi Arabia, failed to intercept and track an incoming Iraqi Scud missile. The Scud crashed onto American Army barracks.

**Cost:** 28 soldiers dead + 100 injured

**Reason:** The inaccurate calculation of time and computer arithmetic error led to system failure. Technically, this was a small chopping error – the system’s internal clock was multiplied by 1/10 (non-terminating) to generate the time in seconds. This calculation was performed using 24 bit fixed point register. That means 1/10 value chopped at 24 bits after the radix point. This led to a significant error, causing missile travel more than half a kilometer [2].

# Y2K

The Y2k (Year 2000 problem) was a problem in the coding of computerized system that was projected to create havoc in computer networks and software in the transition from 31 December 1999 to 1 January 2000.

**Cost:** $500 billion

**Reason:** To save computer storage, most of the legacy software used two digit numbers to store the year for dates, for example “97” for 1997. This caused date-related programs to operate incorrectly after 1 January 2000. In addition, some programs did not take into account that year 2000 was a leap year. Even before the dawn of 2000, it was feared that some software might fail on 9 September 1999 (9/9/99), because early developers often used a series of 9 to indicate the end of a program code [3].

# Wall Street Crash 1987

On 19th October 1987 (also referred as Black Monday), the Dow Jones Industrial Average (DJIA) fell 508 points, losing 22.61% of its total value, and the S&P 500 dropped 20.4% . It was the greatest loss Wall Street ever saw in one day.

**Cost:** $500 billion in one day

**Reason:** Major causes include program trading and overvaluation. In program trading, computers execute rapid stocks based on external inputs, such as the price of related securities. The program trading was supposed to implement portfolio insurance strategies, and an attempt to engage in arbitrage.

In early 1987, there was a rash of SEC investigations into insider trading. By October, investors decided to move out. As people began the mass exodus, computer trading programs generated a flood of sell orders to DOT (Designated Order Turnaround), overwhelming the systems, crashing market and leaving all investors effectively blind [4].

# Pentium’s Long Division

In 1994, Intel’s Pentium microprocessor chip was carrying a bug in floating point unit. For precise calculation, the processor would return incorrect decimal values. There were around 5 million defected chips in circulation and Intel eventually decided to replace all chips for anyone who complained. Later, Intel turned some of their faulty processors into key chains.

**Cost:** $475 million + Brand reputation

**Reason:** The divider in the Pentium floating point unit had a flawed division table, missing five entries out of about a thousand. However, an error is only likely to occur once in a nine billion random floating point divides. For instance, dividing 4195835.0/3145727.0 yielded 1.333739068902037589 instead of 1.333820449136241002, an error of 0.006% [5].

# Hartford Coliseum Collapse

The Hartford Civic Center Coliseum collapsed on January 18, 1978, just hours after nearly 5 thousand spectators left the Coliseum. The steel-latticed roof collapsed under the weight of snow.

**Cost:** $70 million + $20 million damage to the local economy.

**Reason:**There were many conflicting accounts of failure, including design flows, construction and programming errors.The CAD programmer designed the coliseum incorrectly, assuming that the roof supports would only face pure compression. Also, the computer model assumed all of the top chords were laterally braced, but in fact only interior frame met the criteria. Dead loads were underestimated by more than 20%. When one of the supports unexpectedly buckled from the snow, it sets off the chain reaction that brought down the other roof sections [6].

References

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