

CS 6210 Fall 2016

Bei Wang

Lecture 2

Numerical Algorithms

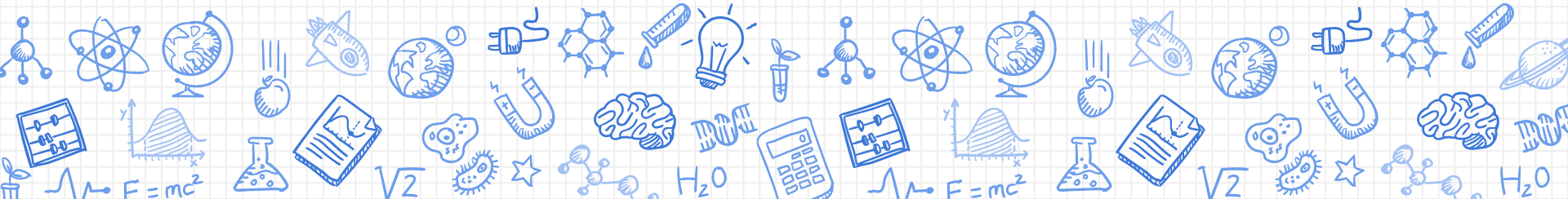


Take home message

1. **How to measure errors?** Absolute and relative
2. **Error types.** Errors in math model; input data; Approximation (discretization, convergence, roundoff) errors.
3. Roundoff error can behave erratically; prefer domination by discretization error
4. **Big O notation**
5. Criteria for assessing an algorithm: accuracy, efficiency, robustness (failing gracefully)
6. Ill-conditioned v.s. well-conditioned problem

Case Study

The Patriot Missile Failure



The Patriot Missile Failure

On February 25, 1991, during the Gulf War, an American Patriot Missile battery in Dharan, Saudi Arabia, failed to track and intercept an incoming Iraqi Scud missile. The Scud struck an American Army barracks, killing 28 soldiers and injuring around 100 other people.

What happened?



From wikipedia





Based on a report of the General Accounting Office

An inaccurate calculation of the time since boot due to computer arithmetic errors.

The time in tenths of second as measured by the system's internal clock was multiplied by $1/10$ to produce the time in seconds.

This calculation was performed using a 24 bit fixed point register.

In particular, the value $1/10$, which has a non-terminating binary expansion, was chopped at 24 bits after the radix point.

The small chopping error, when multiplied by the large number giving the time in tenths of a second, led to a significant error.

This was a matter of Rounding Error!

<http://www.ima.umn.edu/~arnold/disasters/patriot.html>

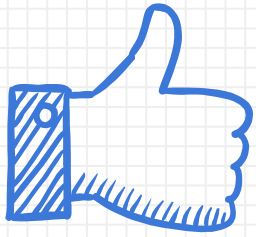
News and Announcement

1. Lecture 1 posted online.
2. Guest speaker on 8/30:

Dr. Mark Kim (SCI):

Fixed-Rate Compressed Floating-Point Arrays





THANKS!

Any questions?

You can contact us via

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