

Instructor Introduces:

Goals

Objectives

Activities

Products

Computational Thinking and Intuition Development

Background

Students read and discuss in groups of 2-3.
Stimulate discussion about their understanding of
computer errors.

Types of Computer Errors (six types)

Each student reads about one type and
describes to the rest of the group.

Error Accumulation in Series Summation

Short lecture by the instructor

Exercise 1: Error Accumulation in Series Summation

Exercise 2: Error Accumulation in Series Summation

Computer Numbers and their Precision II Errors and Uncertainties in Calculations

To err is human, to forgive divine.

- Alexander Pope

Learning goal: To understand how the ways computers store numbers lead to limited precision and how that introduces errors into calculations.

Learning objective

Computational and mathematical objectives:

- To understand that truncation or roundoff occurs when the mantissa of a floating point number becomes too long.
- To understand some of the consequences of the roundoff of floating point numbers.

Science model/computation objectives:

- To understand that just as laboratory experiments always have limits on the precision of their measurements, so too do computer simulations have limits on the precision of their numbers.
- To understand the difference between “precision” and “accuracy”.
- Students will practice the following scientific skills:
 - Doing numerical experiments on the computer.

Activities

In this lesson, students will:

- Perform calculations on the computer as experiments to determine the computer’s limits in regard to the storage of numbers.
- Perform numerical calculations to see how the rules of mathematics are implemented.
- Sum the series for the sine function to see the effect of error accumulation.

Where’s Computational Scientific Thinking and Intuition Development

- Understanding that computers are finite and therefore have limits that affect calculations.
- Being cognizant that uncertainties in numerical calculations are unavoidable.
- Understanding how to obtain meaningful results even with a computer’s limited precision.
- Understanding the range of numbers that may be necessary to describe a natural phenomenon.