
Group Exercise 2: Algorithm Stability

CPSC 302: Numerical Computation for Algebraic Problems

Jessica Bosch
jbosch@cs.ubc.ca
<http://www.cs.ubc.ca/~jbosch>

University of British Columbia
Department of Computer Science

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Outline

1. Announcement
2. Outcome
3. Example
4. Group Exercise 2
5. Reflection

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Matlab Tutorial

- MATLAB Tutorial: Monday, here at 6-8pm
- There will be exercises so bring your laptop and have access to MATLAB.
- You can also work with a partner.

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Today's Goal

To illustrate the potentially damaging effect of roundoff errors.

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Error Accumulation I

Consider the problem of calculating the integral

$$u_n = \int_0^1 \frac{x^n}{x+3} dx,$$

for the values $n = 0, 1, 2, \dots$

1. Derive a formula expressing u_n in terms of u_{n-1} exactly: Find the scalars a and b such that

$$u_n = a * u_{n-1} + b.$$

2. Stable?

Error Accumulation II

We obtain the recursive formula $u_n = -3u_{n-1} + \frac{1}{n}$.

~> Magnitude of roundoff errors gets multiplied by 3 each time.

~> Exponential error growth.

Roundoff Error Accumulation

- In general, if E_n is error after n elementary operations, cannot avoid linear roundoff error accumulation

$$E_n \simeq c_0 n E_0.$$

- Will not tolerate an **exponential** error growth such as

$$E_n \simeq c_1^n E_0 \text{ for some constant } c_1 > 1$$

– an **unstable algorithm**.

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Important

- Groups of 2 up to 4 students

You choose the size – some may prefer smaller groups, some don't.

- We will **not** grade any exercise that has only 1 name on it or more than 4 names.

- **Submit the exercise sheet at the end of today's class directly to your TAs.**

Any delay will not be accepted.

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Reflection

On a piece of paper, answer the following question:

How useful was the group exercise that we did in class today, compared to the last group exercise?

Put the paper into the “Suggestion Box” or just on the table.