

CENG371

Scientific Computing

Spring 2021-2022

Homework 1

Due: April 3rd, 2022, Sunday 23:59

Question 1 (35 points)

Let $f(n) = n \left(\frac{n+1}{n} - 1 \right) - 1$, and $g(n) = f(n)/\epsilon$. Plot $g(n)$ for $n \in [1, 1000]$ where n is an integer.

- a) (5 pts) Include your plot in your PDFs.
- b) (5 pts) Which values of n satisfy $g(n) = 0$?
- c) (15 pts) Explain why $g(n) \neq 0$ for majority of ns .
- d) (10 pts) $g(n)$ seems to grow in size. Why?

Question 2 (65 points)

Generate an array `nums` such that

$$\text{nums}[n] = 1 + (10^6 + 1 - n) \times 10^{-8}, \quad n \in [1, 10^6] \quad \text{where } n \text{ is an integer.}$$

- a) (5 pts) Calculate the theoretical result for the sum of the elements of `nums`. (you can use a summation formula)
- b) (5 pts) In no more than 2 sentences explain the idea of *pairwise summation*. (you can find the algorithm online)
- c) (15 pts) Calculate the sum of the elements of `nums` using
 - 1. naive summation
 - 2. compensated summation
 - 3. pairwise summationin both single and double precision.
- d) (15 pts) Compare the errors and the run times of the methods.
- e) (25 pts) Comment on your results. (you can comment on the cause of differences, possible improvements etc.)

Regulations

- 1. Most of the points will be granted to the **explanation/discussion parts** of the questions. Make sure that you reflect **your own reasoning** in a clean and concise manner.
- 2. Your submission should include a single PDF and your `.m` files.
- 3. Submission will be done via odtuclass.
- 4. **Late Submission:** Accepted with a penalty of $-5 \times (\text{day})^2$.