

**Homework2 due Thu 2023-11-02**

(Create a pdf file containing your work and upload it to Canvas. Note: For problem 2, present data in properly formatted tables. Do not use screenshots as a substitute.)

**1) Error analysis**

Consider the problem of solving  $Ax = b$  for the unknown  $x \in \mathbb{R}^2$  with

$$A = \begin{pmatrix} a & (a-1) \\ (a-1) & (a-2) \end{pmatrix} \quad (1)$$

where  $a \in \mathbb{R}$  and  $a > 2$ . Assuming that the relative error in  $b$  is bounded by  $\epsilon > 0$

$$\frac{\|\delta b\|_\infty}{\|b\|_\infty} < \epsilon \quad (2)$$

compute a bound for the relative error

$$\frac{\|\delta x\|_\infty}{\|x\|_\infty} \quad (3)$$

**2) Using timing functions**

Download the file `timing.zip` from the Canvas Files folder and uncompress it on CSIF.

a) Study and understand the program `timing1.c`.

Compile the program on CSIF using `gcc -o timing1 timing1.c -lm`.

Run the program 10 times with a command line argument of 5000000. Report the timings observed in the output. Repeat the process with arguments 10000000 and 20000000. Discuss the results observed, in particular regarding the resolution of the timing procedure used and the reproducibility of the results between runs. From the observed results, estimate the time needed to compute a square root.

b) Study and understand the program `timing2.c`

Compile the program on CSIF using `gcc` as was done in a). Run the program 10 times with the same arguments as in case a). Discuss the results obtained. Find the clock rate of the processor by looking at the file `/proc/cpuinfo`. Using your timing information, compute the number of clock cycles needed to compute a square root and the corresponding time. Compare with the results obtained in a).