CENG 371 - Scientific Computing
Fall 2022
Homework 2

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Question 1

The algorithms are implemented in the files `shermans.m`, `picketts.m`, and `crouts.m`.

Question 2

Failures:

- When $n > 256$, all algorithms produce no result due to the maximum recursion depth limit.
- When $n > 108$, `picketts` function produces results containing `NaN` values.
- When $n > 80$, `crouts` function produces results containing `NaN` values.

Because of these difficulties, I have tested the algorithms with inputs $A_n = hilb(n)$ for $n \in \{1, 2, \ldots, 80\}$.

a.1)

For $n \in \{1, 2, \ldots, 80\}$:

Total run times of the algorithms are as follows.

- `shermans`: 0.239 seconds
- `picketts`: 0.247 seconds
- `crouts`: 0.262 seconds

This shows us that Sherman's algorithms runs the fastest among the three (according to my implementations).
Relative errors of the algorithms are shown in Figure 1, which shows us that Sherman's algorithms has higher relative error than Pickett's algorithm until a threshold. After that, the things become the opposite while Crout's algorithms has the highest relative error.

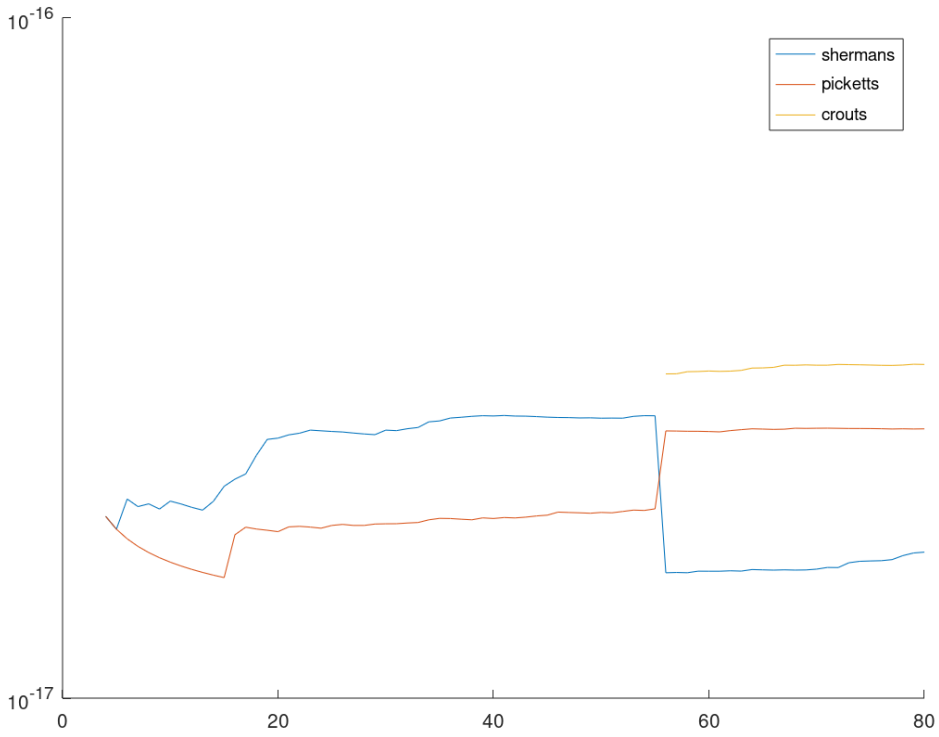

Figure 1: n vs. Relative Error

a.2)

For $n \in \{1, 2, \ldots, 256\}$:

Total run times of the algorithms are as follows.

- `shermans`: 38.657 seconds
- `picketts`: could not measure
- `crouts`: could not measure

Relative errors of the algorithms are shown in Figure 2. The figure shows us that at $n = 109$, there is a sudden increase in the relative error of Sherman's algorithm. After that point, Pickett's algorithm fails to produce outputs. By looking at the values of n where the Crout's algorithm successfully produces an output, we can infer that it has a steady relative error which is significantly less than the Sherman's algorithm.

b)

When I tested the algorithms with simple and small matrices, all of them successfully factorizes the matrices. However, as the input size get larger, while the Sherman's algorithms produces an

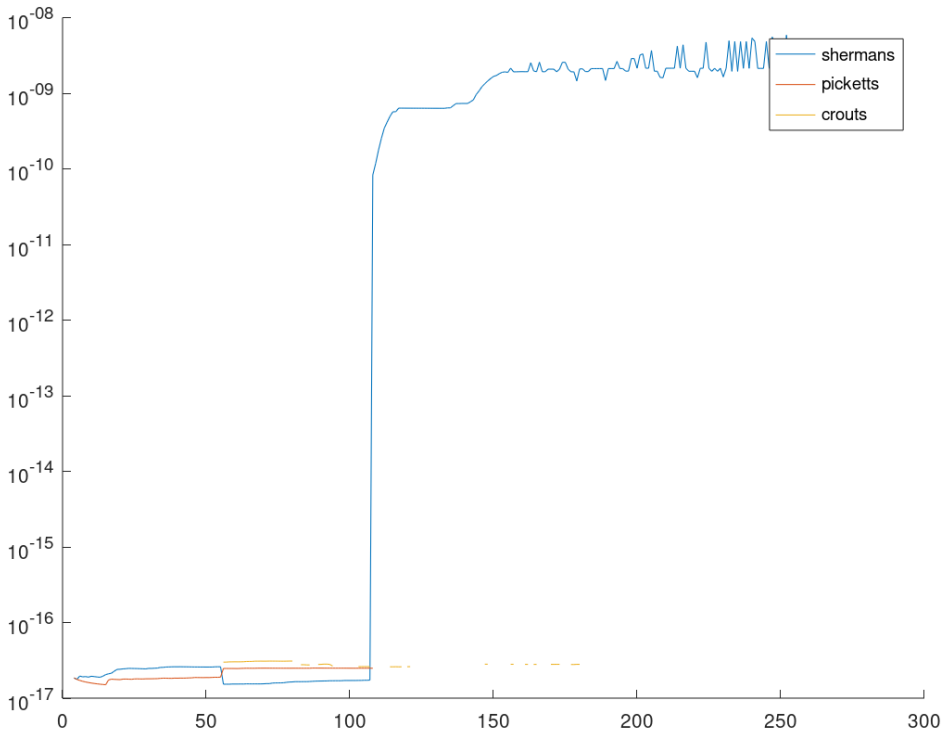

Figure 2: n vs. Relative Error

output with errors, the others may even fail as I have explained above.