Middle East Technical University — Department of Computer Engineering

CENG371

Scientific Computing

Fall 2022-2023

Homework 2

Due: December 2nd, 2022

Question 1 (60 points)

Implement the following algorithms **recursively**

a) **(20 pts)** LU factorization with Sherman's march.
(filename: `shermans.m`, function signature `[L,U] = shermans(A)`)

b) **(20 pts)** LU factorization with Pickett's charge.
(filename: `picketts.m`, function signature `[L,U] = picketts(A)`)

c) **(20 pts)** LU factorization with Crout's method.
(filename: `crouts.m`, function signature `[L,U] = crouts(A)`)

Question 2 (40 points)

Use each of the above algorithms to factorize $A_n = \texttt{hilb}\,(n)$ for $n \in \{1, 2, \ldots, 300\}$.

a) **(30 pts)** Compare the algorithms in terms of their total run times and in terms of the plots of their relative errors $\dfrac{\|A_n - L_n U_n\|_2}{\|A_n\|_2}$.

Note: You can use `tic` & `toc` to measure the elapsed time. Use `semilogy(.)` together with the command `hold on` to display your relative error versus matrix size graphs.

b) **(10 pts)** Do the algorithms you have implemented successfully (up to numerical errors) factorize any square matrix? Explain.

(`hilb` is a MATLAB built-in function. It returns the $n \times n$ Hilbert matrix.)

Regulations

1. Your submission should include a single PDF and your `.m` files.
2. Submission will be done via odtuclass.
3. **Late Submission:** Accepted with a penalty of $-5 \times (day)^2$.