Middle East Technical University - Department of Computer Engineering

CENG 371

Scientific Computing

Fall' 2024-2025

Homework 2

Due Date: 28 November 2024, Thursday, 23:55
Late Submission Policy will be explained below

Question 1 (50 points)

Implement the following LU factorization algorithms **recursively**.

1. **(20 pts)** Sherman's march.
   (Signature: `[L, U] = shermans(A)`)
2. **(20 pts)** Pickett's charge.
   (Signature: `[L, U] = picketts(A)`)
3. **(20 pts)** Crout's method.
   (Signature: `[L, U] = crouts(A)`)

> Please provide a single `.m` file for each method (with the same name). If you are using another framework, try to follow a similar convention (`.py` for numpy/scipy for example). For Question 1, providing the code is satisfactory.

Question 2 (50 points)

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

Note: You can skip every other n if your pc is slow.

1. **(20 pts)** Compare the algorithms in terms of their total run times and terms of the plots of their relative errors $\frac{\|A-LU\|_2}{\|A\|_2}$. Generate solution via Matlab builtin function `[L, U] = lu(A)` (lu link). Incorporate it into your results.

   > You can use tic and toc functions to time measurement, and `hold on/off` directive to incorporate multiple data to a single plot.

2. **(30 pts)** How did your algorithms compete in terms of speed and accuracy? Both compared to each other and the built-in function? Discuss your findings.

Regulations and Submission

- **Programming Language:** You can use any programming language, **however Matlab is recommended**. Other good choices are Python (via Numpy package), and Octave (open source alternative to Matlab). Students can download Matlab (please refer to this link).
- Most of the points will be granted to the **explanation/discussion parts** of the questions. Make sure you **reflect your reasoning** cleanly and concisely.
- Most of your points will come from the PDF text, however; you should submit your code as well.
- Please make sure that your reports are readable, clean, and concise. **Note that the organization of your PDF will also be subject to grading**. You can get bonus/penalty points based on it.
- Uploaded codes should be clean and understandable similar to the PDFs. The codes will not be graded rigorously (such as black-box testing) since there aren't standard language or script arguments. However, these will be visually inspected.
- **Late Submission Policy:** Accepted with a deduction of $5 \times d^2$; where d is the number of late days submitted.
- Submission will be done via Odtuclass, (odtuclass.metu.edu.tr).
- Please upload both your code and your findings (as a PDF) to the system in a zip file.