MACM 316 - Computing Assignment 2

- **Read the *Guidelines for Assignments* first.**
- Submit a one-page PDF report to Crowdmark and upload your Matlab scripts (as m-files) to Canvas. *Do not use any other file formats*.
- Keep in mind that Canvas discussions are open forums.
- You must acknowledge any collaborations/assistance from colleagues, TAs, instructors etc.

In this assignment, you will determine how the computing time varies with matrix size for *large* random matrices when using Matlab's LU factorization algorithm.

Part A: Complete the following, using Matlab's `rand(n)` command to generate random $n \times n$ matrices.

- For each n that you are considering, generate a number of large random matrices and measure the average computing time that Matlab's LU factorization algorithm requires to factor each matrix into L and U. Be sure to specify how many factorizations you are averaging over. In the computing time estimate, do not include the cost of constructing the random matrices.
- Plot the average computing time vs n for a variety of n to visualize the relationship between n and computing time. Choose appropriate scales for the axes in your plot.
- Analyze the plot to determine how the time for computing LU varies with n for large n. Use big-Oh notation to describe the relationship and explain your findings.

Part B: In this question, you are asked to repeat the process in Part A but this time using a random tridiagonal matrix:

Complete the following, using Matlab's `spdiags(rand(n,3), -1:1, n,n)` command to generate random tridiagonal $n \times n$ matrices.

- For each n you are considering, generate a number of large random tridiagonal matrices and measure the average computing time Matlab's LU factorization algorithm requires to factor each tridiagonal matrix into L and U. Be sure to specify how many factorizations you are averaging over. In the computing time estimate, do not include the cost of constructing the random matrices.
- Plot the average computing time vs n for a variety of n to visualize the relationship between n and computing time. Choose appropriate scales for the axes in your plot.
- Analyze the plot to determine how the time for computing LU varies with n for large n. Use big-Oh notation to describe the relationship and explain your findings.

MACM 316 - Computing Assignment 2

Notes:

- *In Matlab, a matrix can be factored into LU by the LU factorization command* `[L,U,P]=lu(A).`
- *The time that a code requires to execute can be measured using the Matlab commands* `tic` *and* `toc`*.*
- *A random* $n \times n$ *tridiagonal matrix can be constructed in Matlab via* `A=spdiags(rand(n,3), -1:1, n,n);`
- *In Part B, use a sparse matrix representation for the matrix to ensure that Matlab understands the zero structure of the matrix. The* `spdiags(rand(n,3), -1:1, n,n)` *command should automatically take care of this for you.*

Your report cannot exceed one page. It should include at least two figures with proper labels. Make sure to choose axis scales appropriate for the data. Discussions should be kept brief and answer all questions asked.

Submit your 1 page report for this question to Crowdmark in .pdf format according the Assignment Guidelines described in the syllabus. Your grade is based on your Crowdmark submission. We ask that you do ***not*** *include identifying information (name, ID number, etc) on your submission.*

Submit your Matlab code to Canvas "Computing Assignment 2 - Matlab Code".

After marking, we will post a few exemplary reports as sample solutions. We appreciate your support on this. If you do not wish to have your report posted, please state so at the top of your report.

Continued on page 3.

MACM 316 - Computing Assignment 2

Grades will be based on 5 criteria:

Figures/Quality of presentation:

2 marks: Well-presented

1 mark: Missing labels, figure is small, inappropriate axis scaling

0 marks: Figures do not present much useful information

Writing / Clarity and conciseness:

2 marks: Writing is clear and concise

1 mark: Contains minor spelling or grammatical errors, too brief or too long, does not convey the main ideas

0 marks: Writing quality is poor and cannot be understood easily or at all

Data:

2 marks: Data is correct and relevant to the report

1 mark: some data is missing, unimportant data is included

0 marks: No data, data is incorrect, data is irrelevant

Part A:

2 marks: Complete and correct analysis and discussion

1 mark: Value is given but discussion contains small errors or is incomplete

0 marks: Analysis and discussion missing, incomplete, and/or incorrect

Part B:

2 marks: Complete and correct analysis and discussion

1 mark: Value is given but discussion contains small errors or is incomplete

0 marks: Analysis and discussion missing, incomplete, and/or incorrect