LAURENTIAN UNIVERSITY

CPSC 5006-EL Matrix Computations

Assignment 1

DUE Thursday, February 1st, 2024

Fundamentals of Matrix Computations, Third Edition

Question 1
(a) Write the system of equations from the following system

$$-\epsilon\, u'' + a\, u' = f(x), \quad 0 < x < 1$$
with boundary conditions
$u(0) = \alpha$ and $u(1) = \beta$

(see Lecture notes, Example 1.2.12 pages 18-19, and the attached document).
(b) Solve the systems by MATLAB, with $f(x) = 1, a = 1, \alpha = \beta = 0$. Consider three different cases where the number of grid points are chosen as $n = 25, 50$ and 100. For each subdivision points change the choice of the diffusion coefficient $\epsilon = 1, 0.1$ and 0.01, (Entering the matrix A and vector b into MATLAB, and using the command $x = A\backslash b$ (to solve the linear systems). Use MATLAB to plot the exact and approximate solutions on the same window for $n = 50$ and different values of $\epsilon = 1, 0.1$, and 1. Comment on your results.

Question 2 Exercise 1.1.9, page 5 (Fundamentals of Matrix Computations, Third Edition)
Consider the following...

Question 3 Exercise 1.3.7, page 27 (read pages 26 and 27, Fundamentals of Matrix Computations, Third Edition)
Write a modified version of algorithm (1.3.5) that checks ...

Question 4 Exercise 1.3.12 (Write a nonrecursive algorithm in the spirit of (1.3.5)...) and Exercise 1.3.14, ((a) Count the operations in (1.3.13) ... (b)

Convince yourself that the row- and ...) page 29 (Fundamentals of Matrix Computations, Third Edition)

Question 5 Exercise 1.4.16, page 38 (Fundamentals of Matrix Computations, Third Edition)
Write an algorithm (MATLAB) based on (1.4.13) and (1.14.14) that checks...
Calculate R of Example 1.4.18 using your Cholesky's Algorithm.

Question 6 Exercise 1.4.21 and 1.4.23, page 40 (Fundamentals of Matrix Computations, Third Edition)
Determine whether or not ...
Rework Exercise 1.4.22 ...

Question 7 Exercise 1.4.25, page 41 (Fundamentals of Matrix Computations, Third Edition)
Prove Proposition 1.4.24.
Proposition 1.4.24 Cholesky's algorithm (1.4.17) applied to an $n \times n$ matrix ...

Question 8 Exercise 1.4.29, page 43 (read pages 42 and 43, Fundamentals of Matrix Computations, Third Edition)
Use the outer-product formulation of Cholesky's method to calculate the Cholesky factor of the matrix B of Exercise 1.4.22.

Question 9 Exercise 1.4.33, page 43 (read pages 42 and 43, Fundamentals of Matrix Computations, Third Edition)
Use the nonrecursive algorithm of Cholesky's algorithm to work Exercise 1.4.22.

Question 10 Exercise 1.4.72, page 53 (Fundamentals of Matrix Computations, Third Edition)
Figure out what the following MATLAB code does...