University of Toronto Mississauga

CSC 338 - Numerical Methods, Spring 2009

Assignment 2

Due date: Tuesday Feb 24, 4:10pm, at the start of tutorial.
No late assignments with be accepted.

Note: The material you hand in should be legible (either typed or *neatly* hand-written), well-organized and easy to mark, including the use of good English. All computer programs should be handed in and should be well commented. In general, short, simple answers are worth more than long, complicated ones. Unless stated otherwise, all answers should be justified.

1. The following exercises from Chapter 2 in the text are to be done by hand.

   (a) Question **2.61** on page 95.

   (b) Question **2.65** on page 96.

   (c) Question **2.4** on page 97.

   (d) Question **2.7** on page 97.

   (e) Question **2.12** on page 97.

   (f) Question **2.17** on page 97.

   (g) Question **2.21** on page 98.

2. The following computer problems are to be done using Matlab or Octave. For each question, hand in your program code and a transcript of a terminal session demonstrating that your programs work correctly. Be sure to indicate clearly which questions the programs and the transcripts refer to.

   (a) (10 points total) Question **2.2** on page 100 (3 points for part a, 2 for b, 5 for c). You should use the Matlab function `lu` to compute the LU factorization of matrix A, and then use the Matlab backslash operator, \, to solve the resulting triangular systems. (For more details, see "LU Factorization" in the Mathematics section of the Matlab help pages.)

   (b) Question **2.3** on page 100.

(c) Do the following:

i. Write a simple program that, given a square matrix, A, computes the elementary elimination matrices M_1, M_2 and M_3. You do not need to worry about the efficiency of this program. Just keep it simple.

ii. Test your program on a random 4×4 matrix, A_1, and on a random 8×8 matrix, A_2. You can use the Matlab function `rand` to generate a random matrix.

iii. For both matrices A_1 and A_2, use matrix multiplication to compute the products $M_1M_2M_3$ and $M_3M_2M_1$. Compare the products to the individual matrices M_1, M_2 and M_3.

iv. For both matrices A_1 and A_2, use standard matrix operations to compute $(M_3M_2M_1)^{-1}$. Compare the results to the individual matrices M_1, M_2 and M_3. You should use the Matlab function `inv` to compute the inverse.

v. Write a faster program to compute $(M_3M_2M_1)^{-1}$. Verify that your program gives the same results as in part iv.

vi. Generate random $n \times n$ matrices for $n = 10, 100, 1000, 2000, 3000, 4000, 5000$. Use the Matlab functions `tic` and `toc` to measure how much time your program in part v takes to execute on each of these matrices. Also measure the amount of time used by the more-straightforward method in part iv. (If your computer cannot handle the larger matrices, don't worry about it.)

No more questions will be added

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Cover sheet for Assignment 2

Complete this page and hand it in with your assignment.

Name: _____
(Underline your last name)

Student number: _____

I declare that the solutions to Assignment 1 that I have handed in are solely my own work, and they are in accordance with the University of Toronto Code of Behavior on Academic Matters.

Signature: _____