MATH 366: Introduction to Applied Math

MIDTERM EXAMINATION 1

A

March 09, 2017

FILL OUT THE INFORMATION IN THE BOX AND SIGN.

Name:_____ Campus Email:_____

I pledge that the work on this exam is entirely my own.

Student signature: _____

READ THE FOLLOWING INFORMATION.

- This is a **70-minute** exam.
- Calculators, books, notes, and other aids are **not** allowed.
- You may use the backs of the pages or the extra pages for scratch work. **Do not unstaple or remove pages as they can be lost in the grading process.**
- Please do not put your name on any page besides the first page.

DO NOT BEGIN THE EXAM UNTIL SIGNALED TO DO SO.

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You can use it for scratch work. Please do not remove it.)

Problem FR is free response problem. Put your work/explanations in the space below the problem.

- **Read and follow the instructions for every problem**.
- Show all of your work for purposes of partial credit. **Full credit may not be given for an answer alone**.
- Justify your answers. **Full sentences are not necessary** but English words help. When in doubt, do as much you think is necessary to demonstrate that you understand the problem, keeping in mind that your grader will be necessarily skeptical.

FR1 (6+8+4=18 points)

1. Perform the forward elimination steps (via row operations), which is a part of the "Gaussian Elimination with partial pivoting" algorithm, to reduce the following matrix A into an upper triangular matrix U.

$$A = \begin{bmatrix} 0 & 2 & -2 \\ 2 & 0 & 0 \\ -4 & 2 & 0 \end{bmatrix}$$

2. Obtain the permutation matrices P_1, P_2 and multiplier matrices M_1, M_2 (as described in class) as you proceed to reduce A to U so that $U = M_2 P_2 M_1 P_1 A$.

3. Use the matrices $P_!, P_2, M_!, M_2$ to obtain a lower triangular matrix L and a permutation matrix P such that $LU = PA$.

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FR2 (3 points) Find the following floating point approximations.

(a) $x = 1.00376542$, precision=4, base=10, $fl(x) =?$

(b) $y = 0.000069911$, precision=4, base=10, $fl(y) =?$

(c) $z = 100.376542$, precision=5, base=10, $fl(x) =?$

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Problem PC is PseudoCoding.

- **Read and follow the instructions for the pseudocode**.
- Do as much as you think are necessary for purposes of partial credit.

PC1 (4 points). Write a function/pseudocode m =my_cumprod(x). which takes a vector x as input and produces the product of all its entries as output.

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PC2 (10 points). Write a function/pseudocode x =solve_upper_sys(U, b) which takes a matrix U and a vector b as input and tries to solve the upper triangular system $Ux = b$. If U is not a square matrix, or if U is not an upper triangular matrix, or if U is singular, then an appropriate error message describing the situation should be prompted in each of the three cases.

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PC3 (5 points). Write a function/pseudocode av =average_geometric$(p, iter)$ which takes a number p and a positive integer iter as input and computes the average number of trials needed (based on iter number of iterations of the experiment) to get the first head, where p is the head probability in each trial. It should prompt an error message if p is not between 0 and 1. Recall that the command rand produces random numbers from the interval $[0, 1]$.

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